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SERIES IN
Political Economy and Public Law

No. 17

THE ORGANIZATION OF OCEAN COMMERCE

BY
J. RUSSELL SMITH, Ph. D.
Instructor in Commerce, University of Pennsylvania

Published for the University
PHILADELPHIA
1905

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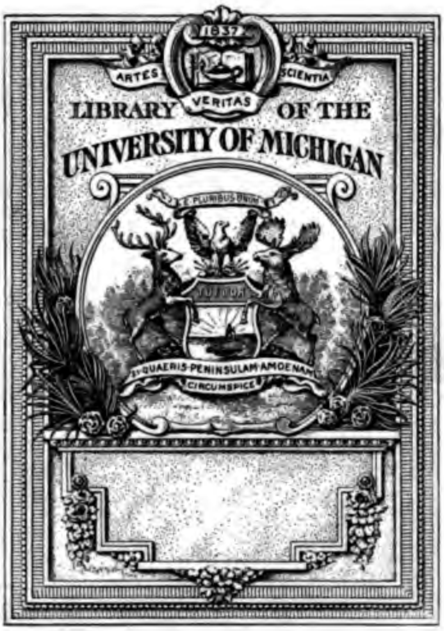
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PREFACE.

This monograph is the result of two lines of work. From 1899 to 1901 the author assisted Professor Emory R. Johnson with the economic investigations which he, as a member of the Isthmian Canal Commission, made to ascertain the relation of the proposed canal to the industries and commerce of the United States. This investigation required a minute study of the commercial effects which this waterway would have upon the management of the maritime trade of the United States, and upon much of the commerce of Europe with Pacific countries. This subject proved so interesting that the author continued the study of the question for two years subsequent to 1901, one year being spent in Europe and the other at the University of Pennsylvania.

The monograph, a result of this study, has been written with reference to the general reading public, and to high school and college students of commerce. For two years the author has conducted a course in the Wharton School of Finance and Commerce of the University of Pennsylvania dealing with the subjects considered in the monograph.

The author desires to acknowledge his indebtedness to Professor Emory R. Johnson, of the University of Pennsylvania, whose counsel has been of assistance throughout the preparation of the volume; and to Mr. Frank L. Neall, senior member of the firm of Peter Wright & Sons, of

Philadelphia, for much information and for letters of introduction to many European ship owners, from whom valuable assistance was obtained.

Acknowledgment is hereby made of the assistance received from the Carnegie Institution of Washington in the collection and preparation of materials for this monograph.

Wharton School, University of Pennsylvania,
March 1, 1905.

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CHAPTER I.

INTRODUCTION.

Character and Importance of Ocean Commerce.

If the world's trade were divided into two classes, on the basis of distance, it would be found that land traffic was pre-eminently the short-distance trade and that the ocean was the route used mainly by the long-distance trade. Owing to the ease of water transportation, men seek out the ocean routes for freight whenever possible, and, as from any sea all seas may be reached, the average length of water routes is several times as great as the land routes.

The ocean carrying trade is chiefly international trade, of which it comprises the most important part. The ocean is the great international highway, and, in the sense of ownership, the only international highway. Many land routes carry commodities that cross international boundaries, but the routes, like all the valuable land in the world, are within the jurisdiction of some particular country, and, further, are the property of particular persons or groups of persons. The ocean is more international because it is the property of all, and open and free to all. No nation claims more than three miles from its coast and beyond that any man from any nation may sail his ship where he will over the common ocean, which covers three-fourths of the surface of the globe and washes the shores of all important countries.

Besides being large and free the ocean furnishes the cheapest of all forms of transportation, and with these advantages it is natural that maritime commerce should be by far the greater element in international exchanges, as well as a very important part of many domestic trades.

While the ocean is the dominant factor in foreign trade, the relative importance of foreign trade itself must not be overestimated. In all the leading countries it is of secondary importance to the domestic trade. In Great Britain, with an insular position, and the highest degree of industrial development yet attained, it is estimated at one-third of the whole, and in the United States the vast foreign trade furnishes less than a tenth of the total exchanges of the country. The increase of local industries is likely to produce further decline in foreign trade, for it naturally follows upon the growth of manufactures within the customs' confines that there is a smaller proportion of human wants that remain to be supplied by foreign trade. But this fact of proportional decrease of foreign trade should not be allowed to obscure the more important fact that, while foreign trade may have a smaller part proportionally, it is growing rapidly in value, still faster in volume and promises to continue that growth in both of these particulars.

The actual amount of foreign trade is in itself enormous, and it is predominantly ocean commerce. In the case of Great Britain all of it goes by sea. In the United States about nineteen-twentieths is sea-borne. On the continent of Europe land boundaries are long, and the overland trade is important, but in no case, with the exceptions of the inland countries and the semi-inland like Austro-Hungary and the Balkan States, does it equal the over-sea trade.

Ocean commerce has a strong hold on the future because of the importance of the articles comprising it. They are essential to civilized life. The rising standard of life of civilized man makes greater dependence upon ocean commerce, because nearly every individual in the community has in his daily consumption some commodity or commodities which have come from over sea, and this consumption of foreign goods goes on now, not in the houses of the rich only, but to considerable extent in the cottages of the laborer throughout America and to a lesser degree in Europe also. Even the barbarous and semi-savage peoples have some dependence upon commerce and almost invariably upon ocean commerce, because, with a practical absence of local manufactures they have come to depend upon the looms of Western civilization for part of their clothing, and parts of their food are sometimes obtained from over sea.

The commodities of ocean commerce are often the necessities. It is by no means always the case that ocean commerce is in necessities only. But if it is not, it is usually in commodities that are necessary to the maintenance of those habits of living that combine to make the standard of life of civilized man. Indeed, this rising standard of life is almost or quite a necessary accompaniment of or perhaps a part of the progress of civilization itself. The materials to support this rising standard are supplied by ocean commerce, which thus has, in the deeply fixed and increasing wants of both civilized and semi-civilized man, an explanation of its steady growth.

While the freights carried upon the ocean are a part of the daily round of business, and the daily life of peoples, the ocean remains a world apart. Its plants and animals, its odors and climate, differ from those of the land. The men who go down to the sea in ships affect a life different from that of the landsmen, and have their different modes of locomotion. The student of transportation finds that the rules and concepts that may be applied to his science by land, do not always apply to transportation by sea.

The most pronounced and far-reaching difference between ocean transportation and land transportation arises from the fact that the ocean *is* a highway without the efforts of man, and the navigator has but to provide his vehicle. By land roads must be made even for a pack train and with the railroad, the modern type of land transportation, the building of the roadway is much the greater part of the necessary equipment. For carrying upon the ocean the completion of the ship is all that is necessary, and if she be a sailer the winds of Providence will drive her into all seas and around the world. This fundamental difference in the ocean trade produces many peculiarities unknown upon the land. Because of the smaller capital that is required upon the ocean, we find more individuals and groups of individuals acting independently than we do in the railway traffic of the land. The single vessel operated as a unit has as much independence as the great line of steamers, and in some respects more independence. Both are alike free to pass over the high seas, to take advantage of the government surveys thereupon and to enter the harbors that connect with the land. The activities involved in this part of the world's transportation furnish the questions to be discussed in this monograph: the work and types of the individual ships and the line of ships; the routes of the ocean and the care exercised upon them by governments; and the construction, management and activities of the harbor by which the ship reaches the land and finally completes her work.

PART I.—Traffic.

CHAPTER II.

THE CHARTER TRAFFIC.

From the standpoint of historical development, and also from the simplicity of the service rendered, the first subject to take up in a study of ocean traffic is the operation of the single vessel that is managed as an independent unit. Such vessels do not attract much attention. They come and go unnoticed in news columns of the public press unless perchance they meet with accident, and the reading and travelling layman does not often have his attention called to them. They do not carry his mail, his baggage or his person. These choice and exacting services are rendered by the aristocrats of the deep, the great liners, whose names and performances and owning companies are known by tens of thousands of people scattered over all parts of the reading world. The advertisements of these ships, photographs included, reach the inland hamlets of the five continents, and their movements are heralded as news by numerous journals. They are very important. They carry passengers, mail and much freight with speed, regularity and high cost, and for that reason they do not and cannot do all of the ocean's work. The single ship gives a cheaper service and there is therefore a large part of the world's ocean carrying left for it to do, and it is done with little comment or public notice.

If every port in the world had a large trade, made up of a wide variety of articles shipped in fairly even quantities throughout the year, there would probably be no vessels operated singly. With such an even and dependable commerce ships could be organized into lines which would handle the traffic in regularly recurring shiploads. But those conditions of evenness and variety and dependableness do not exist. The nearest approach is in the great commercial ports such as New York, Liverpool, London, Hamburg. In these ports the per cent. of traffic in the line vessels is increasing and that in independent vessels is decreasing. One cannot generalize on world commerce from the world's great ports, for they are few in number and the small ones are very numerous.

During the decades that have made up the railway era many new lands have been opened to commerce, new products introduced, new ports established. In the vast majority of the many hundreds of ports upon the world ocean, the bulk of the commerce is limited to a very small variety of articles, often a single article, and that again is often shipped during only a part of the year. It is most likely to be a raw product, cheap and heavy, which must be carried at as low a rate as possible. This then is not work that can be done by the carefully organized line of vessels. This simpler, unorganized and cheaper service falls to the independent vessel that is for hire, and works as a unit wherever there is work to be done. These vessels are built and owned for just this work. The contract that the lessor and lessee sign when the vessel is hired is called a charter, and the ship is spoken of as being chartered, but if regularly for hire she is commonly called a "tramp." Such vessels carry a large share of the world's trade, and are utilized for any freight that may go in shipload lots. For the carrying of raw materials, and cheap, heavy or bulky goods, the regularity and promptness of the line vessel are not often required. Cheapness is the prime factor. This is true of a long list of commodities, of which grain is the most important; then come minerals, ores, coal, nitrate of soda, phosphate rock, salt, flint, chalk, china clay, sulphur and case petroleum; vegetable products are lumber, raw sugar, raw cotton, hemp and jute. Sometimes heavy manufactures, as steel rails, locomotives and machinery are shipped in quantities large enough to make full cargoes.

As the prime requisite of the charter traffic is cheapness with safety, the combined efforts of the marine architect and the shipowner have been toward economy in cost of operation, while the managers of liners are often striving for regularity and speed regardless of cost. The economies of the tramp steamer fall under three classes:

1. Construction.
2. Navigation.
3. Management.

1. The tramp steamer is built on a sort of general average model to fit her for as many kinds of service as possible and to go into all oceans. The first object of the designer is to fit her for holding much cargo rather than making high speed. These two diverse objects in design give a great difference in the result. The sharp bow and curved ribs of the fast line steamer are replaced in the tramp by a blunt bow, a flat bottom and straight sides, producing in her model a strong resemblance to the cubical form of a section of a squared log.[1] The keel of romance is replaced by a steel bottom as flat as the floor of a warehouse. The keel, as a center of construction, is inside rather than outside the line of the hull, enabling the ship to store freight in every foot of her depth. To prevent the rolling of the vessel, this freighter has bilge keels—fin-like strips of metal rivetted to her hull near the blunt angles between the bottom and the sides. With her flat bottom she can cross bars to enter the shallow harbors of any ocean, and engage in almost any trade. It need scarcely be stated that the carrying of passengers is not provided for in the building of these

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[1] The ship builders' term, "block coefficient of fineness," shows the per cent. that the ship's displacement is of the content of a circumscribing parallelopipedon of the following dimensions: length on the load line, draft and breadth. This coefficient for an ocean greyhound is about sixty-two per cent.; for a nine-knot tramp steamer, about eighty per cent.

freight ships. The line vessels are usually built with some peculiarities of design fitting them for the particular trade of that line, and they lack the adjustability and the cosmopolitanism of the tramp.

The labor of handling ballast for the modern tramp is obviated by having in the bottom of the ship water-ballast compartments, which can be filled and emptied by machinery in a very short time, and while cargo is being received or discharged.

2. The economies of navigation group themselves around the central question of speed. It is a fact in mechanical engineering that high speed is attained at much greater expenditure of power per unit of speed than low speed. In automobile tests a four horse-power car has made fifteen miles per hour, but seventy horse-power was required for sixty miles per hour. The increase in fuel required is in a similarly high ratio, sometimes approaching in steamships the square of increase in knots per hour. The fast steamer, in addition to a form that does not make resistance in passing through the water, must have enormous engines and heavy coal consumption, and larger crew to handle it. These factors mean more expensive construction, less space for freight because of engine room, coal storage and crew quarters; more expensive operation because of greater wear of machinery, and costs of coal and crew. The advantage side of the account arises from the fact that there are more voyages in a year and consequent greater carrying power, and because of the speed higher freight rates may be charged. But at twenty, twenty-two or twenty-four knots per hour the cost of this service is more than traffic in raw materials can stand.

At the other extreme of the mechanical question is the fact that low speeds cost a surprisingly small sum. A steamer could make four knots per hour with modern engines at a very small percentage of the cost required for twenty knots, but she would make such a small number of voyages per year and command such low freights that it, like the high speeds, would not be profitable for freight carrying. For freight carrying there is a point of equilibrium in speed above which additional speed costs more in outlay than it adds in income, and below which a lessened speed costs more in loss of earning power than it saves in operating expenses. This point of equilibrium rises with every improvement in engine construction. At present the usual speed for tramp steamers is about nine knots per hour, and it may be confidently expected to increase, some of the newest steamers being already somewhat above it.

These comparisons between the chartered vessels and the liner may be brought out more clearly by the examination of the actual facts of operation of typical vessels of each class.

The "Baron Eldon" is a British tramp steamer, built at Sunderland (1899) for general work. The gross tonnage is 3,705, net tonnage, 2,385, and the crew, 29 men, all told. Her dead weight capacity is 6,100 tons, and she has actually carried as cargo 5,360 tons of coal on one voyage and on another 5,550 tons of rice. Her coal consumption at nine knots per hour is 22 tons per day. The "Kaiser Wilhelm II" and the "Cedric" are two of the most modern of ocean giants, and built for the North Atlantic line traffic. The "Cedric" is not a racer, however, and has a displacement of 37,870 tons, will carry 18,400 tons of freight, 3,000 passengers, a crew of 350 and has a coal consumption of 260 tons per day at 17 knots per hour. The "Kaiser Wilhelm II," built to break all speed records, has a displacement of 26,000 tons, will carry 20,000 tons of freight, 1,888 passengers and has a crew of 600, with a coal consumption of 750 tons per day at 24 knots per hour. She could beat the "Cedric" by about two days in a voyage from New York to Liverpool, but to make this gain her crew is nearly doubled and the daily coal consumption nearly trebled. The coal consumed by the "Kaiser Wilhelm II" in one day would run the "Baron Eldon," with more than one-fourth as much *freight* and one-twentieth the crew, for thirty-four days, and carry her from New York to Liverpool and back to New Orleans. In this comparison the fact should not be overlooked that the "Kaiser Wilhelm" carries 1,888 passengers. The "Baron Eldon" carries none, but the mere addition of staterooms and other passenger accommodation would not greatly reduce her freight capacity. The main difficulty lies in the fact that passengers do not desire so slow a vessel.

3. The economies of management are possible because of the lack of dependence upon other ships and because the work is always of a temporary nature. The tramp has no schedule, and is free from the exactions of any particular round of engagements or the disadvantages of any particular route. She undergoes no unnecessary dallying at ports waiting for sailing day. The coming of passengers, the arrival of mails, long time contracts to carry certain freight, none of these handicaps of the liner affect her movements. As soon as her special cargo is loaded she is dispatched without loss of time. No further time is lost in making unprofitable calls at intermediate ports, and as soon as her destination is reached she is free to unload and seek further employment. No announced schedule requires her to be run, half empty, over a certain route or to lie in port awaiting freight as advertised. She has the freedom of the seas to seek freight in any port in any continent, to take advantage of any local condition, any single shipment, that may appear to her advantage. If a bad harvest in America cuts off the grain export, the tramp that had been working in the North Atlantic may seek freights at the mouth of the Danube or South Russia or in the Indian Ocean or in th East Indies; wherever freight is offering, there may she g

As there is no effort to hold patrons and develop a client there is little expensive advertising done, and the simpli of the cargoes requires a minimum of office force.

The business of managing this charter traffic is one o most characteristic developments of the world commer the present era, the epoch of the ocean cable. Several sands of ships are scattered over the oceans of the commercial world, engaged in a traffic that is supplied by hundreds of ports in all climes and all continents, from Greenland to New Zealand. Every day scores or even hundreds of these independent vessels are seeking freight to carry. It is a complicated world puzzle to bring together the ships and the freight so that the one may be most profitably employed, and the other most economically carried. The work is done by the ship brokers and steamship agents, who receive their pay in the form of a commission or brokerage, a percentage on the transaction. In all shipowning countries these firms have their headquarters, and each one has agents and "correspondents" in many other countries, so that among them all they make a complicated web that reaches to all cities of commercial importance. The whole is so bound together by telegraph and cable that, like a spider's web, if touched by anything of importance at any point the whole structure vibrates with the news. The departure of a steamer loaded with sugar from a small port in Java or ore from Chile, is reported by telegraph in Europe and America. There is practically a complete record of all vessel movements published daily by Lloyds, the great British firm of underwriters. The men engaged in world commerce have, through their world telegraph, a world community of information.

The method of securing cargoes for ships, and ships for cargoes, is best described by the relation of some common incidents of every-day occurrence. A Liverpool shipowner had a steamer in the Mediterranean loaded with jute, which she was carrying from Calcutta to Dundee. The owner desired another cargo for the steamer at the end of the voyage. Knowing that there was nothing in Dundee he wrote to his agent in Newcastle, and himself made inquiries among the shippers of Liverpool. The Newcastle man suggested a cargo of coal to Hamburg, but it was declined, and he sought the aid of his correspondent in Dumbarton, but the iron trade of Dumbarton was not promising. Meanwhile the days were passing, the vessel had reached Dundee and there was nothing provided for her. The Liverpool man was himself the correspondent of a London firm of ship brokers, who telegraphed him at this juncture that they had offers of a shipment of German coke to go from Rotterdam to Santa Rosalia, Lower California, and of another of Cardiff coal for Buenos Ayres. The first the shipowner declined, as being only suitable for a sailing vessel, and because of news from across the Atlantic he allowed the second to go to a steamer then lying at Antwerp. Three days before this he had cabled to his New York correspondent a description of the steamer, and offering her services to carry grain to the United Kingdom at a certain rate and saying that she could load after a certain date or between certain dates. As New York freight was dull, the firm in that city telegraphed their Boston and Philadelphia agencies. At the same time a Chicago grain exporter decided to export 150,000 bushels of corn, and telegraphed to his agents in New York and Philadelphia to secure offers of transportation. In the shipping exchanges of those cities the representatives of the Chicago exporter and the Liverpool shipowner bargained face to face. Offers were, however, made at the same rate by the New York representative of the owner of a ship then off Rio Janeiro with a cargo of Chilean nitrate bound for New York, and also by a Philadelphia broker who sought future employment for a vessel then in the Red Sea with a cargo of Java sugar for Philadelphia. The Liverpool owner was informed of this competition, and still having nothing for his steamer he cabled that he would charter his ship for threepence (6 cents) less per ton or for the same rate he would take freight to continental ports as far as Copenhagen. He added to his cablegram the word "range," which means in cable code that he would send the ship to the Delaware Bay with the understanding that she might be ordered to New York, Philadelphia, Baltimore or Norfolk to load. This offer secured the freight, for the representatives of the sugar ship and the nitrate ship having more time at their disposal preferred to take chances rather than cut rates. The steamer, which, pending negotiations, was still lying at Dundee, proceeded to Newcastle to coal, and departed thence in ballast for the Delaware. Meanwhile the Chicago exporter found that railroad conditions made Norfolk the most convenient port to deliver his corn at the appointed time. When the steamer reached the Delaware Breakwater (just inside Cape Henlopen) the captain received telegraphic instructions to go to Norfolk. There he loaded a full cargo of corn and, as the final destination of the corn was still undecided, he sailed to the Channel port of Falmouth for orders. There he was instructed by signal to proceed to Copenhagen, where the corn was discharged and the vessel was ready for another contract which the agents had been trying to arrange since the day they learned of the final destination of the corn cargo.

That operation is typical of scores that are enacted daily. In almost every exchange of ideas connected therewith, the ocean cable or land telegraph plays an important part. The manager of a merchant fleet may control his ships almost as perfectly from his office in London, Liverpool, Hamburg or New York as does a chess player the men on a board before him. There are signal stations over the greater part of the world where the captain of a ship can receive cabled instructions from the central office. It is common to send vessels to sea with the final destination unknown, the captain reporting at some prearranged signal station where he receives further instructions. This is true of vessels with cargo en route to destination, or of vessels without cargo and seeking it. Nearly all of the grain ships going from the Pacific Coast of the United States to the United Kingdom sail to Cork, southwest Ireland, "for orders" announcing the final destination. Whether the cargo is to be finally consigned to a port in Britain or any one of four or five continental countries is decided by the grain shipper according to the latest market conditions. Vessels bound for northwest Europe, via Suez, often receive final orders at Gibraltar or

Falmouth or Lizard's Point. If coming up the South Atlantic, orders are received at Cape Verde or Madeira Islands. A typical case is that of a vessel, which, lying idle at Singapore, was ordered to proceed for orders to a signal station in Lower Burmah. While en route her owner in London sought cargo. By having the vessel go to Lower Burmah he had the possibility of getting a cargo of rice from Rangoon, or proceeding to Calcutta if cargo offered there. By ordering his ships from station to station the owner or manager on the shores of the North Atlantic keeps in touch with his scattered fleet in the Indian Ocean, Eastern Asia, Australia or the East Indies almost as easily as if they were a mile or two away in the harbor of his own city. Practically all of the voyages referred to, or to be referred to in this chapter, were arranged in part or entirely from the home ports on the North Atlantic, usually the ports of Great Britain. When the vessel is at sea she is out of the reach of her owner's telegrams, but when she touches land she is in the vast majority of cases in contact with some part of this world mesh of telegraph wires and cables. The map of ocean cables shows many parts of the world to be devoid of any connection, but a map of important ocean trade routes will show that these routes are all touched by cable at many points. In skirting the shores of each of the five continents the navigator is never far from a connection with the world cables. It is so also in Australia, the West and East Indies and the Philippines, and the more important islands of both Atlantic and Pacific are also connected. There is a vast stretch in the Central and Western Pacific, between Hawaii and Java, where there are no cables, but it is an unfrequented part of the world and crossed by no route of importance.

Science holds out the possibility that the wireless telegraph may place the owner in constant communication with his ship in all places and under all normal conditions.

The tramp vessel has earned the name by her absolute freedom of restraint to particular localities, routes or trades. In the constant search for freight she may traverse every sea, and in the course of years often circumnavigates the globe many times. This roving tendency is increased by the fact that so much of the work done by these vessels is of a seasonal nature, a certain region shipping its product at a certain time only. California wheat is ready to ship at a different season from that of the Argentine Republic or India. The corn of the Mississippi Valley is ready to ship later than the wheat from the same region. There is a different sugar season for Hawaii, Peru, Java and Germany. There is a cotton season and a nitrate season, the latter being decided by the greater demand for nitrate fertilizers in the spring planting time of the northern hemisphere.

The seasonal nature of the traffic adds to the complexity of the business of ship management. The shipowner has to keep in mind not only the conditions of the contract he is making, but also the prospects ahead of the ship when she must again seek cargo. It is like a game of chess, in that each move must be made with regard to succeeding moves. The shipowner is glad to arrange a voyage that will release the ship in a good location to secure freight, and loath to send her to regions that are devoid of freight, and rates are made accordingly. A cargo of lumber would be taken at a lower rate to New Caledonia, with its export of ores, than to some coral isle in the mid-Pacific with no export but a few cocoa nuts. Thus the possibilities of two or even three voyages enter into the decision of the rates for one. The manager of vessels that happened to be in India or Java or South America would give, under usual conditions, a relatively more favorable rate for a full cargo to New York than to London, because he is reasonably sure of getting a profitable freight cargo away from an American port, and an unprofitable coal or ballast cargo away from Great Britain. As a result of judgments of this character steamers are sometimes started upon a chain of voyages requiring months to complete. For example, a man in London may have an opportunity to secure a cargo of goods from Liverpool to China, and he takes it because he thinks that by the time his ship has reached China he can arrange for a cargo of Java sugar to New York or Philadelphia, and from that point he can get grain back to Liverpool or London: or the same man might send his ship from London out with a cargo to Australia, because she could there get a cargo of coal and take it over to Chile in season to secure a cargo of nitrate for a European or American port.

The tendency of the tramp steamer to rove is intensified by the fact that none of the world's great trade routes has equal amounts of freight moving along it in both directions. North America sends across the North Atlantic more than twice as many tons of freight as Europe sends back. China and Japan import twice or more than twice as much (in bulk) as they export, and the Dutch East Indies, the west coast of South America and the Pacific Coast of the United States all export more than they import. As a consequence the tramp vessel cannot expect to secure cargo both ways and regularly run back and forth on the same route. Ordinarily the tramp must expect, if carrying a profitable cargo, to pass over a certain route in a certain direction, the direction of heaviest freight movement. The ideal of the manager is, therefore, to have his ship always discharge one cargo at the profitable or surplus end of another trade route. This is clearly impossible. The world's freight cannot be carried without sending vessels to places where there is no return cargo. The fewer the voyages of this character, the greater is the profit and skill of the manager. But voyages without cargo must be taken even under the most careful management.

Lacking cargo the vessel must take ballast to steady her, and for this cause thousands of tons of useless sand, earth and stone are carried from country to country. But rather than take ballast for nothing the tramp vessel can afford to carry bulky cargo very cheaply, so it happens that coal and sometimes ores are carried practically as ballast substitutes, and at, or even less than, the actual cost of running the ship. The voyage must be made to secure profitable cargo at the other end, and the cheap coal freight is that much clear gain. Shipowners are sometimes compelled to send vessels from England to the Pacific Coast of the United States with no choice but to carry sand or coal, and with plenty of competition for the coal. Under these conditions the product of the Welsh mines has been carried from Cardiff to San Francisco for eight shillings a ton, while the return cargo of wheat paid thirty-five or forty, or fifty or more shillings a ton, and gave the shipowner his profit.

The distribution of coal by ocean carriage may, in most cases, be considered a by-product of the charter traffic There are some cases where coal is carried short distances in lines of vessels especially built for the purpose, but this represents but a small proportion of the total coal carriage. From the consideration of the by-product phase of the carrying trade it is evident that nations are in the best position to export their products cheaply when they import a greater quantity of merchandise than they export, for there is then competition among the shipowners to get the outgoing freight. For this reason the greatest coal exporter is Great Britain, the greatest importer of bulky freight. Next, in respect of the wide distribution of this product, come Australia and Japan, both fourth-rate coal producers, but countries whose imports are more bulky though less valuable than their exports. These countries are able to export coal widely, yet in none of them is coal so abundant or cheap as in the United States. The United States has not become an important coal exporter, except to adjacent countries, because the heavy exports of raw materials have employed more shipping than our imports required, so vessels come to us in ballast, and a ship that carries coal from an American port must usually return in ballast, making it necessary for the coal freight to pay for both voyages. This cannot be done, because the somewhat more expensive British coal is carried at very low rates as ballast cargo and undersells the American in most foreign ports. The American export of coal is limited almost entirely to Canada and Mexico and to the

West Indies, whence we are importing iron ore, sugar and woods, all of them bulky articles, and the outgoing vessels carry the coal. In contrast to this British coal goes more than half way round the world.

Another factor which the manager of chartered vessels must consider is the price of coal, which if imported varies exceedingly, being affected by the nearness of the port in question to a good supply of outgoing cargo for the coal-carrying ships. A recent schedule of prices of Cardiff coal shows that it is lower (twenty-two shillings per ton) at Constantinople than at Madeira Islands (twenty-five shillings and sixpence) because the Black Sea offers abundant outgoing cargo and the Madeira Islands do not. The working of this principle gives high-priced coal in remote situations, as at isolated and unproductive islands in mid-ocean. Exceptions to this rule are found where there is export cargo, as in Hawaii with sugar and in New Caledonia with ores to export, but in Tahiti, Samoa, Midway Island, Guam, the Aleutians, St. Helena, St. Vincent (Cape Verde) and in most other oceanic islands coal must continue to be high in price if taken there at all. This question will be taken up more fully in the chapter on coaling stations.

The successful manager of a fleet of tramp steamers must be an astute student of commercial geography, and have a view of the entire world. His business demands a knowledge of the commercial condition and requirements of every important country, and the crop conditions and crop prospects of the leading producing regions. This information is given by special reporters and published in the commercial press, where it becomes the basis of the grain speculators' actions in the exchanges, and at the same time the guide to the shipowner in the disposition of his fleet. In addition to watching the world's crops, he must also watch the world's ships. To do this requires a skillfully kept bureau of information with elaborate catalogues keeping track of hundreds or thousands of ships. They must be watched, because it would be a calamity to all owners concerned if twenty tramps should congregate in a port with cargo for ten, and it would be a successful stroke to be the owner of one of five that had a temporary monopoly of the traffic in the same port.

On the basis of this knowledge of freight and ships the manager must predict the future, place his ships accordingly, and thus stake his capital on his prediction. Sometimes the best foresight cannot prevent expensive mistakes. In 1901 there were glowing prospects of a large wheat crop in Australia and a heavy surplus for export. This promised employment for scores of vessels, and shipowners in America and Europe sought opportunities to get their vessels to Australia. Many of them accepted cheap freights or small cargoes out, depending upon the return cargo of wheat for the profit. The vessels were started before the wheat was harvested because the first vessels there would secure the freight. During the forty-five to sixty days necessary for these vessels to reach Australia the withering winds from the desert interior of that continent had blasted the wheat crop so that there was none to export. The shipowners had played and lost. Their ships were in Australian ports with nothing to do and each ship costing many, sometimes even hundreds of dollars a day. They had to be sent elsewhere seeking cargo. Some went to Java for sugar, some to Burmah for rice, some to India for jute or wheat, some to Chile for nitrate, some to Hawaii for sugar, and some steamers even were compelled to go to San Francisco and take wheat for the long and expensive voyage around South America—a traffic which before that time had been almost exclusively carried by sailing vessels and one in which steamers had no chance whatever of making profit.

CHAPTER III.

LINE TRAFFIC.

The chartered vessel, whether sail or steam, renders a cheap, safe service, but it is also slow and uncertain, and cannot meet all the requirements of modern commerce. It is suited to the carriage of raw materials, but rarely for manufactures, and this is an age of manufacturing. The raw materials carried by charter are often returned in manufactured form to the country of their origin and are usually transported in line steamers which sail on a schedule, enabling the importer to depend upon certain and prompt delivery at a date that can be approximately known in advance. The parts of modern ocean commerce requiring especial attention, the exchanges of articles of high value per ton, require, because of that value, the more dependable and expensive service of the line vessel.

The regular service in its turn stimulates trade by its regularity, and is a necessary part of the commerce of highly civilized states. Passengers cannot make their arrangements to sail on vessels whose time of departure is uncertain. Like the mails, the passenger traffic requires a definite schedule of sailings, which must be made out months in advance, and announcement made of the day and hour of sailing. Certain classes of valuable freight are scarcely less exacting and there are many lines of vessels carrying freight only that are made to follow an advertised schedule almost as punctually as do the passenger lines.

The distinction between line traffic and charter traffic is in some cases hard to point out. The difference between the work of the best trans-Atlantic liners and that of a typical tramp steamer or sailing vessel is unmistakable, but there is a point where the two kinds of traffic approach each other closely and, from the standpoint of the vessel, there are many cases in which the distinction cannot be drawn at all, because many vessels pass repeatedly from one service to the other. This transition service is best explained by describing the methods of operating some of the cheaper all-freight lines.

With these, as all other lines, the amount of freight to be carried fluctuates, and the company will often own only enough vessels to attend to a sure minimum of business, and when temporary increase of traffic comes the managers turn to the ship market for additional vessels to be taken on time charter and operated in the line service so long as it seems expedient to do so. When trade decreases the charters of these vessels are allowed to lapse and the fleet is reduced. In this work steamers are often chartered for a year or even two years if rates promise, in the opinion of the charterer, to be steadily rising. Vessels are also taken into the line service for only a single voyage, particularly where there is much more traffic one way than the other. It is common for some of the lines regularly carrying freight from New York to Australia to charter vessels for the out voyage only. On this route returning freight is so scarce that the vessels owned by the companies often become tramps or are "put upon the berth" at the end of the voyage, and work their way back to New York by whatever indirect route offers the best chance of earning freights. In the trade between New York and China similar freight conditions prevail, and it is a common, almost a regular, occurrence for some of the companies operating steamship lines in that trade to announce the date of a steamer's sailing when they cannot give her name, because they have not yet chartered her. Any good tramp steamer may be secured for the assignment at the latest available date.

This elasticity of service is not possible with the lines having passenger service, specialized freight traffic and vessels especially adapted to the trade and built for it. A fleet of such vessels cannot be enlarged by chartering at will.

Another confusion in traffic distinctions is the berth traffic, which will be more fully described in the chapter on rates.

It is really a hybrid between charter and line service, in that a vessel which may have discharged either line or charter cargo is loaded with many consignments, like a liner; but dispatched for one irregular voyage only, like a tramp. When such a vessel is loading she is said to be "put upon the berth."

Despite this traffic of uncertain qualities there is a vast line traffic having pronounced differences from the charter traffic. From the standpoint of traffic these differences may be summarized in the two words, regularity and speed, or in two others, increased efficiency.

The high efficiency of the best modern lines is the slowly evolved and dearly bought result of centuries of experience and growth, and is found in increasing degree on those routes which have the greatest and most valuable commerce. While the development of the best type of modern line has taken centuries, every step of the progress is in sight to-day in the varying trades of different sections of the world. The annual trading vessel goes in August to Hudson's Bay and the coasts of Greenland, and the same kind of commerce may be found occasionally in some ports of Polynesia. Thence upward the stages of organization pass through all forms of service until we come to the splendid lines from New York to Europe. From this one port there weekly depart more of the fine, high-type passenger and mail steamers than there are days in the week.

The efficiency of the line of steamers is only obtained by incurring certain expenses that are not necessary if the vessel is working independently and carrying special cargoes. These expenses may be classed under the heads: 1. Maintenance of schedule. 2. Management and advertising. 3. Costly construction. 4. Speed.

1. The most important single factor about line service, the schedule and its maintenance, is one of the great cares and costs of the managers. When a vessel is scheduled to sail on a certain date, her time may be up before she is fully loaded, or she may be loaded or ready to load and have to

wait till the appointed time. Both are expensive to the owner. In keeping up a regular schedule it may be necessary to enter ports when the freights do not warrant the delay and the cost.

In contrast to this is the freedom of the chartered vessel, which sails as soon as she is ready, can be delayed without any further inconvenience than the loss of time, and proceeds only to such ports as best suit the particular conditions of a particular voyage.

Accidents fall with cumulative force upon a steamship line because of the effect upon the schedule. In addition to the direct loss due to the accident, the future sailings and service are often demoralized, and the fulfillment of outstanding contracts becomes a matter of great difficulty and financial loss rather than profit. If a ship is disabled a few days before time for putting to sea, her place must be filled, and it is difficult and often costly to secure a good steamer in an emergency or even to secure accommodations elsewhere for the passengers and freight that have been engaged. Such necessary shiftings may make a month or more of losses where high profits were expected.

2. Line traffic, particularly when an object is made of carrying passengers, requires a large amount of advertising to catch and keep the attention of the would-be traveller and to create the desire for travel. Allied to the advertising is the elaborate arrangement of offices and agencies in many cities for the selling of tickets and the securing of freight. At the port of sailing, the office of the steamship agents managing a high-grade steamship line requires an efficient force of clerks. The staff must be organized on the basis of its ability to manage the work at the times of greatest rush—sailing day—although it may be partly idle in the intervals.

To handle the line traffic in freight requires more clerical work and more warehouse room than the same amount of charter traffic, because of the greater number of shipments to be received, invoiced, cared for till loading time, placed safely in the hold of the ship and finally assembled at point of discharging cargo. Such cargo is often spread out in separate lots over a large area of quay or warehouse space. The bulk shipment of grain or other uniform charter cargo can be discharged more easily into coasting or river craft alongside or it may be thrown in great heaps, so that it occupies less warehouse space than any other kind of cargo.

3. Many kinds of line traffic require special types of ship construction. First among these is the passenger service, which is provided for wherever the travel is sufficient to give passengers for a part of each year. Human freight is more exacting than inanimate cargo, and while the business is very profitable, it adds greatly to the cost of construction of the steamer, increases the crew and decreases the freight space.

Many kinds of freight require nearly as much special construction as do passengers. This statement applies especially to perishable goods requiring refrigeration. There is a large traffic in frozen meat between Great Britain and the southern hemisphere. The frozen carcasses are taken from a cold-storage warehouse in Argentina or Australasia and carried to Europe in the ship's freezing chambers. Another division of the refrigerator traffic is the larger and rapidly growing use of chambers where the freight is chilled, but not frozen. In this manner is carried the American fresh meat en route to Europe, and most of the ocean trade in fruits and dairy produce. Some other forms of special construction are found in ships prepared for carrying live cattle, and in tank steamers for the carriage of oil in bulk, and the fruit steamers that carry oranges and bananas from Caribbean and other tropical countries.

4. High speed is not a necessary part of all line traffic, but it is an essential factor and a large element of the cost in those lines carrying passengers and mail, and in some freight lines. The increased consumption of coal has been referred to in the chapter on the charter traffic. High speed requires, along with greater coal cost, greater crew to handle the

coal, larger bunkers and machinery space, and consequent lessened freight space. Machinery running at high speed wears out sooner and requires more repairing per mile than when operated at lower speed. The fast vessel is also more liable than a slow one to accidents at sea, especially collisions.

As a compensation for the various costs the line steamer has several strong advantages over the chartered vessel. 1. It can charge higher rates of freight on some goods. 2. It can secure more advantageous loads through mixing cargo. 3. It wins patrons and develops trade through acquaintance.

1. The liner monopolizes the passenger traffic, the carriage of the mails and because of its speed or regularity, or both, it can charge a higher freight rate for much valuable cargo in the transportation of which time is an important factor.

2. In the carriage of ordinary freight the liner has an advantage in its ability to secure mixed cargo, and stow into a given space more tons of freight than can usually be secured by the special cargo vessel, which ordinarily carries a cargo of one article only.

The question of the relation of the bulk of cargo to its weight is a very important one for the ocean carrier. The ship has a certain capacity in dead weight tons, and an absolutely inelastic amount of cubic space into which those tons must be stowed. It is important that both space capacity and weight capacity be utilized, and to do this there should be some heavy cargo to give the weight and some light to fill the space. A full cargo of either is unsatisfactory.

The ocean carrier solves the problem by basing his freight rate on two different units, one of weight and one of cubic contents. Both are called tons, the weight ton and the measurement ton, the latter consisting of 40 cubic feet. The shipowner exercises his discretion as to whether he receives freight on the weight or measurement basis, and, of course, uses the one most favorable to himself. The measurement ton happens to have its particular size because a weight ton of wheat occupies about 40 cubic feet, and as wheat has long been a staple, and often the greatest staple of ocean commerce, shipowners came to think of their vessels in terms of their wheat-carrying capacity, and this grain became the norm for measuring other commodities. Freight goes by weight or measure, at the discretion of the carrier. Hence a shipping company's report of the number of tons of freight carried, gives neither an accurate measure of weight nor cubic content of the traffic, because it is usually composed of unknown quantities of both kinds.

A mixed cargo will give a greater cargo tonnage than a full cargo of either kind, because all vessels will contain more heavy cargo than they can float, and they will float more heavy cargo than their space can contain. A vessel that can carry 1,000 tons dead weight would have four-fifths of her space empty when carrying a full cargo of iron. On the other extreme, a full cargo of wagons or wooden manufactures would not weigh more than 300 or 400 tons. In one case the ship is wasting space, in the other carrying power; but with 700 tons of iron or steel in the bottom of the hold there is still space for possibly 700 tons of light measured cargo, say, wagons—1,400 freight tons in all. The possibility of making such combinations is constantly before the managers of line vessels, and freight is sought and rates are made with such arrangements in view. If 1,400 freight tons of wagons and steel rails can be put into the vessel that can only carry 1,000 tons of rails alone, the agents can well afford to take both articles at a rate somewhat lower than could have been offered for a full cargo of either, and yet have greater returns than would have come from a full cargo of a single commodity at the full rate—1,000 tons at $5 per ton equals $5,000 and 1,400 tons at $4 per ton equals $5,600.

The steamer is also much safer to navigate with a full dead weight rather than a light measurement load.

3. The line has also the advantage of getting regular patrons, of making contracts for long periods and of reaping the advantage of the increased trade that its regularity fos-

ters, but it must also maintain its reputation and preserve that regularity of performance during periods of depression and loss.

In view of the character of the freight carried and the work done by the steamship line, it is evident that the greater the variety and the quantity of trade from a port, the better the field becomes for line rather than charter traffic. The line depends for prosperity upon the steady flow of trade, and by the law of averages this is best furnished by the tens of thousands of different shipments that monthly pass from such ports as London, New York, Liverpool and Hamburg. It is in such all-round, complex and heavy trades that the lines have the leading and most rapidly increasing share of business. The percentage of line traffic is increasing in Hamburg, it is greater in New York than in Philadelphia or Baltimore, and plays but a comparatively small part in the trade of such undeveloped ports as Galveston, Pensacola, Sourabaya (Java) or Rosario (Argentine Republic).

The charter traffic is crowded out of the great ports because with the great quantity and variety of manufactured goods the articles that usually go to make charter cargoes are taken by the liners as ballast cargo to make the ship ride steadily in the water. It has now become an unusual thing for a full cargo of grain to be sent from New York, because nearly every great passenger ship can ordinarily take a partial cargo of it to advantage and a cheap rate is offered to secure it. This rate is less than the charter rate is or would be if there were one. This fact should be borne in mind when examining the chart on page 43.

It is significant of the tendency to line traffic that the greatest combination of shipping lines, the International Mercantile Marine, was organized for trade across the North Atlantic, the ocean having the heaviest and most varied trade in the world. While this company does business in many ports, its working headquarters are at New York, the city with the heaviest foreign commerce in the world. The International Mercantile Marine is the natural outcome of the developments of the nineteenth century, and in a vast and already established trade this combination of lines will be able to affect large reductions in running expenses. It carries into the consolidation of many lines the advantages attendant upon wholesale production.

In the operation of steamship lines there are many economies that come with the increase of the size of the business. The larger the operations of the line the more cheaply may it perform a unit of transportation service. The saving comes from numerous causes.

1. The larger business can spread its organization and traffic arrangements over a wider area than can a small one. It can issue through bills of lading for a vast number of shippers, take their goods to a wider market and by this advantage hold their business. By carrying the freight of many scattered communities, the business is steadied because the local fluctuations have a tendency to equalize each other. A strike, a series of failures, a drought, an epidemic and quarantine, or any disaster that embarrasses trade is much more serious in its consequences to the steamship line that trades at two ports than to the line that trades with five or ten or fifty.

2. In the insurance and building of ships the large line has an advantage. The vessels can be built in pairs or in greater numbers, and the duplication reduces the cost. The International Mercantile Marine has gone farther than this, and practically includes in its organization one of the finest shipyards in the world, where building and repair work will be done at very favorable rates. The corporations owning many ships can also do their own insuring and thus save the profits of the insurance company. A line with ten steamers cannot risk carrying its own insurance, because the loss of one vessel in ten would be too great to bear. When the number under a single ownership becomes one hundred or more the insurance situation changes. The loss of one ship in a hundred is not sufficient to seriously embarrass a well-managed company, so the larger companies often set aside

a certain percentage of their earnings for insurance, and if the vessels are carefully navigated the insurance fund may accumulate for profits. In periods of depression some of the largest companies have paid small dividends from the surplus of the insurance fund. It is not necessary that the company's insurance department do all of the insuring. If the risk seems too heavy, a part of it may be carried by one of the regular insurance companies and a part by the steamship company. This method of combined insurance is much commoner than total private insurance.

3. The large company has a great advantage when it manages lines to different parts of the world and can shift its ships from one service to another. Every steamship line has seasons of heavy and of light trade, and the ships that can handle the traffic at the busy season are partly idle in the dull season, and it is a great gain if they can be placed upon another line and profitably employed, thus rivaling the tramp in adjustability. This method of using line ships has been best worked out by the German lines. Some of the fast passenger steamers that run from New York to Hamburg and Bremen in the summer, when travellers are hurrying to Northern Europe, are changed to the southern route in winter, and run from New York to the Mediterranean. The Hamburg-America Company operates lines connecting Hamburg with Canada, with New York and other ports in the Northern States, with the Gulf and Mexican ports, with the West Indies, with South America, both east and west; with South Africa, East Africa, the Mediterranean, India, East Asia, the East Indies and Australasia. There are lines built especially for passengers and others especially for freight. With this great variety of services, it is much easier for the company to keep its ships all well employed by transferring them from one line to another as the seasons and the replacing of ships require. As ships improve and the demands become more exacting, the older vessels of the best lines can be permanently transferred to the cheaper lines. Thus the vessels built for the New York service may be transferred

to Boston or Philadelphia or Baltimore, and then to a purely freight service in any part of the world, and finally they may end their days as coal storage hulks in some distant harbor.

4. When the traffic of a steamship company has once attained the size at which the management can afford to have offices of its own, the relative cost of office expenses decreases as the business increases. In the first stages of a steamship line its business is managed by some shipbroker or agent, who calls himself general agent, and is assisted by others in distant cities calling themselves agents. They are paid by a percentage on the freights secured. As the business of the line increases, this percentage after a time becomes large enough to pay the cost of an independent office. It thus comes about that all the larger trans-Atlantic lines have their own offices at the port of departure and frequently in many inland cities, to secure freight. In Chicago there are branch offices or agencies for steamship companies operating from all leading ports from Montreal around to New Orleans. The work that such an office force can do increases much faster than the number of men employed.

The International Mercantile Marine Company represents a consolidation of five such companies, each with an independent organization built up and practiced in the competition for the American freight. Much of the activity of these corporations was due to their keen competition with each other, and one of the first results of the union of the companies was the closing of some of the duplicate offices in New York and other cities. This saving went partly to reduce expenses and partly to make the organization of the new company more effective and wide reaching than any of its constituent companies had been.

5. Better use of the ships will result in a large saving to the consolidation. In the days when the five companies competed for the traffic several ships often sailed on the same day, and they were often partly empty. The new company operates them in regular succession, and a successful effort is made to do the same amount of work with fewer ships

more fully employed. One of the first acts of the new corporation was the sale of several ships that were building for one of the constituent companies. The cost price and the operating expenses of these new ships was a direct cash saving resulting from the combination.

Dock space can be economized in the same way that it is possible to reduce the number of ships. Each company had to have space enough for its busiest season and some of the space was idle most of the time. With the consolidation of companies, the more regular sailings give a more even distribution of work, the freight flows in a stream rather than in occasional accumulations and less space is required to handle it.

This more even employment of the shipping and the docks resulting from better distributed sailing days, is a gain to commerce in general, for commerce is improved by anything that increases its dependableness and its evenness.

6. The combined companies will make a considerable saving because of the ease of supplying ships in emergencies. If an accident detains or disables a ship, any of the four other companies stand ready to supply a substitute, and the contract of the International with the German companies provides that before going into the open ship market each company shall give the other the opportunity to supply extra ships. That practically places the ships of seven of the largest lines at the disposal of the American or German managers when an accident disables a ship.

The above enumeration of economies is not claimed to cover, but rather to suggest the advantages that result from the growth and combination of steamship lines and the extension of organization in the world's carrying trade. The presentation of economies, and the mention of the International Mercantile Marine, should not be taken as a prediction of the success of that particular company. Along with the economies of consolidation it has taken the burden of a high capitalization.[2]

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[2] For a discussion of this point see "Political Science Quarterly," March, 1904.

Why cannot all ocean freight be handled by such great corporations?

The possibility of the organization of ocean commerce into traffic for steamship lines is directly increased by anything that increases the evenness and regularity of industry, and consequently of the export and import of goods. As the strength of a chain is the strength of its weakest link so the line traffic is in a measure limited by the amount of traffic to be had at the lowest season. The surplus, the spurts, may be partly taken by the lines, but they are quite as apt to fall to the share of the tramp. Wars, droughts and crop failures from natural causes must apparently continue, but if the great fluctuations of industry resulting from panics and depressions may some day cease, there will be an extension and perfection of organization in the ocean carrying trade.

CHAPTER IV.

OCEAN FREIGHT RATES.

The rates of ocean transportation differ from the rates in land transportation both in cost per ton mile and in the greater freedom and force of competition. The rates are lower in ocean transport because the roadbed costs nothing. The chief reasons for the greater freedom of competition may be classed under three headings:

1. The ease of transfer of shipping from country to country over the world ocean.
2. Lack of alternative employment for the tools of ocean transportation.
3. The freedom of roadway and the consequent freedom from investment of fixed capital.

1. The ocean is a world route free for all, reaching all maritime countries and all ports, and the ship, complete in itself, is able to go wherever freight is to be secured. The cheapness and ease of movement over the ocean make the whole world the possible field of operations of any ship. Wherever the open sea extends there she is at home and may compete. This mobility and ease of concentration is not possessed by any other agent of transportation. The railway train is tied to the tracks controlled by its own company, the wagon and team are physically unable to move any great distance, and landsmen generally are ordinarily bound by their homes to a comparatively narrow field of operations.

2. Competition in transportation may be limited, if there are other fields of activity for the carrier, when freight rates become too low to be profitable.

The owners of ships have no outlet but the carrying trade, and they must continue to compete for that or give up their ships. It is otherwise with the older agents of transportation. The caravans and the wagon trains, the dog sledge and the carriers in the forest, all possess other avenues of employment. The carriers and the drivers of the dogs may go hunting or go at other work. The members of the caravan and the wagon train may employ themselves and their animals at agricultural labor, and by this relief set limits to the extent that they may be driven by competition. Within these limits competition is free, but there are no such limits to the carrying trade of the ocean. The ship must be operated or become a total loss, and it is not unusual for them to be entirely idle at times. But the railroad, even under the fiercest competition, has a certain amount of local traffic of which it cannot be deprived. Compulsory idleness or loss of profitable work falls heavily upon shipping because of the very rapid depreciation through disuse, and when traffic is dull the costs of operation are proportionally higher than with the railroad. Thus the railroad, although possessed of no alternative employment, fares better than the ship, both in respect to loss of traffic from hard times and from the financial losses resulting from loss of traffic.

3. The most fundamental difference between ocean transportation and land transportation as typified in the railroad, is in the element of fixed capital, the roadbed and terminal facilities, which are so all important with the railroad and upon which the steamship company spends so little. This may be called an organic difference between the two. It profoundly affects the making of rates, for the railroad has a tendency to combination, monopoly or agreement, resulting in fixed and settled rates, while the ocean is free, open to competition and the scene of ever-shifting rates.

This non-competitive characteristic of the railroad did not exist among the early lines in the first decade of railroad experience, but it is now generally recognized and is becoming increasingly evident. The first railways were built with the idea of continuing the freedom of the country road. The public highway, like the ocean, was free to all; any person's wagon could use it. The laying of the first rails was the application of no new theory. It merely made it easier for the horses. Anyone could use the new highway as he could a new turnpike. When the steam engine came it was with the idea that it would pull the wagons of the community just as the stage coach had carried their packages. But this practice of public use did not survive, because it was not suited to the new conditions of steam transportation. The wagons needed to be of uniform pattern, strong build and special form. The rapid improvements in the locomotive and the track required large capital, and the railway and the rolling stock soon passed into the hands of the private companies owning the tracks. The community recognized its public right or proprietorship, as it still does, by giving a permit (charter) to the company and imposing certain conditions upon it before the road can be built. Further than this, the first railroads were chartered by legislatures acting upon the idea that other roads would be built, that they would compete and in the end give as much advantage of competition as exists on the wagon road or the ocean. This theory has not been fulfilled in practice. The competing railroads have in many cases become actually or practically united so far as rates are concerned. This consolidation or agreement arises because of the essential difference in the physical requirements necessary for the transportation by railroad and upon the ocean.

The mere tools of transportation constituting all or nearly all of the property of the wagon- or shipowner, are but a small fraction of the railway's property. Its strength lies in the road itself, the route, the strategy of location. It is in these forms of investment that the greater part of the railroad company's capital is placed. The steamship company has no such investment, except the possible rental of wharves or warehouses. The railroad must own land. The terminus in the great city is costly, not so much because of the building itself, but because of the great expense of buying valuable lots and houses to make room for the approaching road and in building the costly roadway. All this capital is fixed, cannot be moved or put to any other use. Competition may injure the business by making rates and income so low that no interest can be paid on this capital. Consequently the railways unite. The union may be a voluntary agreement to maintain rates or it may be an involuntary consolidation, brought about by the bankruptcy and sale of some of the weaker roads to the stronger after the financial wrecks wrought by competition. The result is that one railway corporation comes to be supreme in a certain territory, often a large territory, and within this there can be no other independent carrier capable of competing.

To be independent, a carrier must control the unit of transportation. By railway the unit is not only the cars and engine, but the road itself, often a hundred times more costly. By sea the unit is a ship. The shipper may load his ship and sail away to any ocean, continent or island. He pays nothing for the privilege of going, nothing for the maintenance of way and may easily build another ship or hire one, and any other individual may do the same. Hence, while land transportation tends toward monopoly, ocean transportation tends toward freedom of competition.

There is a certain amount of fixed capital concerned in the ocean carrying trade, that employed in the construction of the terminus, the harbor.

From the standpoint of public interest, and the investor's interest, these improvements may be divided into two classes. (a) The wharves, docks, freight sheds and freight-handling appliances—structures directly employed in the loading and discharge of ship's cargo. (b) The waterway approaching the harbor, the channel, which usually must be deepened, lighted, buoyed and kept in order by constant expense. There is also a large difference in the relation of private enterprise to these two classes of terminal improvements.

(a) Wharves, docks and appurtenances. These may sometimes be the property of private individuals and of shipping corporations, but it is never necessary for the shipowner to own terminal facilities before being able to discharge or load his vessel, although it may be more convenient. From time immemorial the waterways, and along with them the harbors, have been free and public as the land highway. The practical working out of this idea makes it possible for the occasional ship to find a place to discharge even in a harbor like that of Philadelphia, where the piers are held in private ownership. Here the captain of an incoming vessel asks the harbor officials for accommodations, and may be assigned to any temporarily unused private wharf. Here we see full private ownership overridden by the sense of public right. In no country is private ownership allowed to interfere with the right of all parties to use the harbor. In many of the harbors of Europe and America the harbor improvements are owned by state, national or municipal governments for the benefit of the community, and where private companies are permitted to build wharves or docks the permission is always hedged about with provisions making private monopoly impossible, and usually making the improved facilities open to all alike upon the payment of a uniform toll, similar in theory and practice to that levied by the turnpike companies as return for service rendered. These improvements for toll collections are not considered a part of the business of transportation, nor have they been commonly undertaken by the persons and corporations engaged in the business of ocean transportation.

(b) Channel improvements are of a nature so costly, and in their use so ill-suited to the derivation of income and so closely allied to national sovereignty, that this field of activity has been usually left to the action of governments, either municipal or state. In Great Britain some of this work has been done by voluntary associations of private individuals, but not for private gain.

The introduction of the locomotive has revolutionized the practice of the greater part of the world concerning the rights of the public in regard to the use of railways by all carriers, but steam has produced no similar change of practice with regard to waterways, harbors and ports. The relation of the harbor to the public welfare is too vital and too evident to permit it to be given away or sold, or compromised in any kind of grant or charter to private parties. Every seaport town has unlimited ambition for trade, for foreign trade, for many lines of ships, for connection with all parts of the world. Such a desirable situation can only be attained, if attained at all, by having the most free and favorable access to the high seas, the universal highway. Any monopoly of the harbor for private rather than public gain would certainly handicap the community. This act is recognized in the action of all communities. No city will sell its commercial birthright to any shipowning firm, because no firm can offer in return so complete a service as every city desires. The greatest of shipping companies reaches but a small proportion of the world's commercial ports; supplies but a fraction of the variety of transportation necessary for a world trade.

Theories often outlive the facts that gave them rise, as is seen in the way legal theory in this country regards competition as the governing force in railway matters.

In ocean commerce, however, the facts and the theory are alike alive. New harbors are being opened and old ones improved, and the public must and does constantly exercise some form of control and guidance.

The idea of public or community right in a harbor is kept more distinctly alive because in the beginnings harbors are usually only sheltered places, where the ships are met by small boats that carry the freight to the shore; changes come gradually, developing around this idea of the public highway and preventing the entrance of monopoly.

While the sense of public right has prevented monopoly the shipowning class has not, through most of its history, desired to own harbors and make fixed investments on shore that depended upon ships for the profit. It has rather been the desire of the shipowner to preserve the mobility of his capital and enlarge his fleet, so that he could trade first with this city, then with that, taking advantage of the best harbors and the best trades everywhere. It paid better to multiply ships than it would have paid to undertake to improve harbors. Harbor improvements that can be utilized by the commerce of an entire port are often not capable of earning interest directly on the investment. If the dues were high enough for such profit, commerce might be driven to other ports. The same result would probably follow if the steamship company had to get money from freight rates to run the ships and pay for a harbor, too. Failure would probably result to the private company, because of the competition of some more favorable port. But a community can afford to raise such money by taxation and get its return in the indirect profits that come from increased commerce — increased industries, land values, population and power.

During the latter years of the nineteenth century conditions arose having in them the possibility of profit for a single corporation owning, improving and monopolizing a harbor, but it is quite as much as a part of land as of ocean transportation. The unprecedented accumulations of capital have produced railroad systems with thousands of miles of track and operating in connection with steamship lines, which serve as their feeders, and which are often under the same management or ownership.

Nearly all of the American transcontinental railroads have steamship lines to China and Japan, and the Southern Pacific has also a line from New Orleans to New York. The Canadian Pacific runs steamers from Canada to the United Kingdom and from Canada west to the Orient. Some of the British railway companies operate steamship lines to the Continent and, lastly, the International Mercantile Marine Company represents in a remarkable degree the united action of several of the greatest American railroad companies. A corporation of such magnitude, having even greater interests and alliances on land than upon the sea, might be willing to take over at cost the harbor of Philadelphia or Boston and make a profit from the operation. Their willingness to do this is, however, uncertain, the possibility of profit is uncertain; but it is certain that the physical possibility of such a transaction has come at a late day and when the public control of private business has advanced so far that it will never even be considered. The ocean and the harbors are open to all, are free to competition and will remain so. The typical ship and line of ships, so far as freight rates are concerned, represent so much movable capital devoid of connection with fixed capital on shore.

What is the effect of this freedom upon the making of rates for ocean freighting?

This question can be best answered by an examination of the practice of ocean carriers in dealing with the two types of cargo that are presented: first, the full cargo, loading an entire vessel; and, second, partial cargo, which may be five hundred tons, a single ton or a single package.

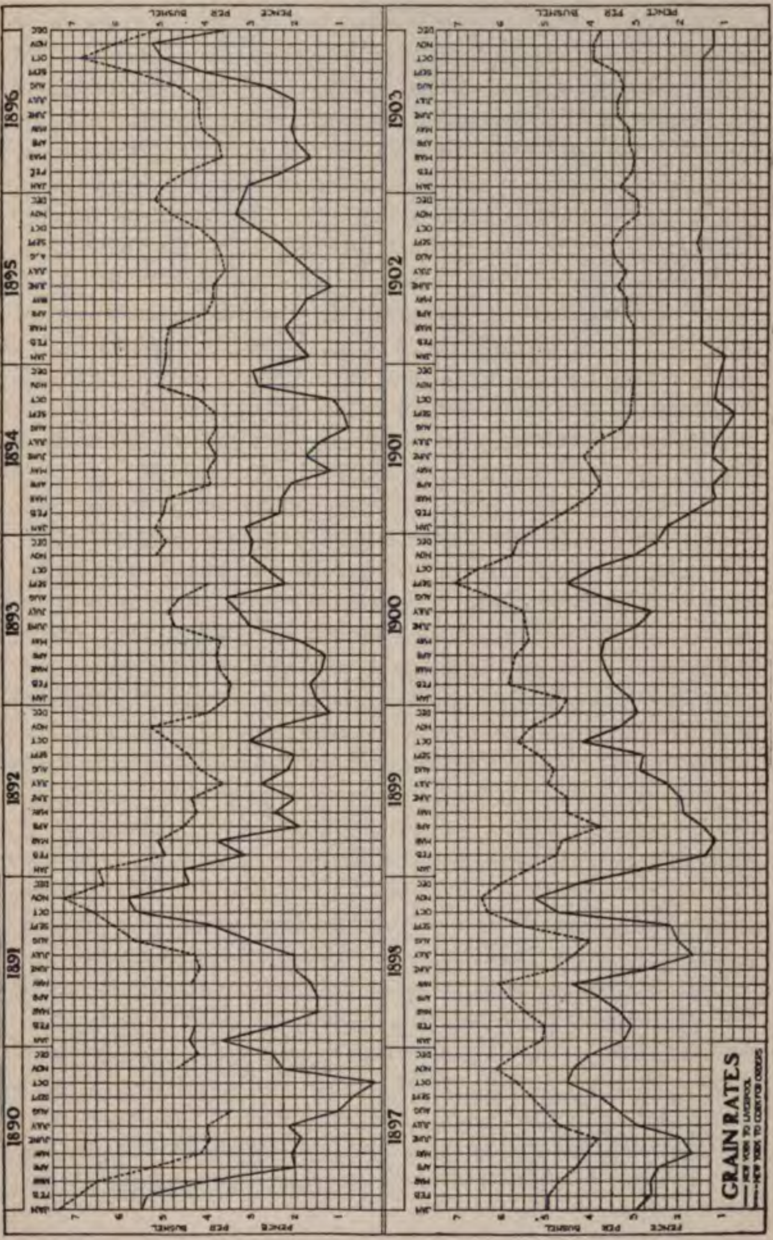
1st. Full cargo and partial cargo shipments differ radically in the conditions of rate making. The man with a small shipment is necessarily dependent upon some form of co-operative enterprise, whereby his small freights may be combined with others, and he must pay the current rates. In this respect the small shipper by sea may be likened to the shipper by railroad who has less than a carload lot. The large shipper over sea may be likened to the man who can secure the more favorable carload rates by land, but this likeness may not be carried too far. The independent unit is much larger by sea than by land, and much more independent because of the greater freedom of competition. The ocean owes this freedom of competition to the unchartered tramp vessel that may be seeking cargo. For the man who is able to dispatch a whole cargo at one time, ships are to be had for purchase or for the hire, and can be secured for a single voyage, for a month, a term of months or for a year, and are, during the period of the lease, the property of the man who has hired or "chartered" them. The charterer may arrange these contracts under a great variety of conditions, if he will but pay the price then current in the world's ship market. What the price may be is forever uncertain and is decided by a vast amount of bargaining, dependent upon the supply of ships and the demand for them. The bargaining for a horse trade at an oriental fair could not be freer and more absolutely decided by supply and demand. The rates for chartering depend upon the number of ships within reach. If ships are abundant, they are cheap, very cheap, and may be had below actual running expenses; if they are scarce, and freight is plentiful, they are very dear and the business becomes exceedingly profitable.

These fluctuations of rates may be general, world wide and of considerable duration, or they may be local in extent and of short duration. It may come about that several ships happen by combinations of winds, weather, accidents and previous freighting arrangements to be ready to receive cargo in the same port when there is not enough freight for more than half of them. Some of the ships must go elsewhere and bear the loss of a ballast voyage. The managers of any of the vessels would, of course, find it profitable to reduce the freight rate to some point that would still leave a margin over the probable income to be derived from going in ballast to the next available port and engaging freight at the there existing rates. If one vessel offers a low rate, all must do so, and the rate in that over-supplied port falls. Later, if there happens to be an excess of freight over ships, it may rise as suddenly as it fell.

An excellent example of temporary fluctuation was afforded during the war between China and Japan in 1894. Ocean traffic was dull, rates were low and idle ships were common. At the outbreak of hostilities some were engaged to carry supplies from Europe and America to the Orient, and many others were sent thither from the North Atlantic during the summer in the hope of securing service in the transportation of war supplies. In September the European markets demanded heavy grain movements from the United States, and the supply of available vessels being deficient rates in some ports rose 300 per cent. in two weeks. But the demand was not enduring, unemployed vessels hurried back from the Pacific and Indian Oceans to share in the good times, and in two months rates in the Atlantic had declined nearly as much as they had advanced.

It sometimes happens that a revival of world commerce produces throughout the world an excess of freight over shipping. Every ship is eagerly sought for, and rates rise and rise until a high equilibrium is produced by the increased cost of transport, making it impossible for some of the freight to bear the cost of carriage. At such a time the shipowner's profits are great, and he desires and builds more ships until another equilibrium is produced, a low equilibrium, set by the point at which the shipowner thinks declining rates will make his business unprofitable. This point in practice is difficult and well-nigh impossible to determine, certainly impossible to attain or maintain; because the amount of available freight can never be foreseen far in advance, and it requires several months to complete a ship, once it is begun. The probability of an oversupply of ships being produced during a period of prosperity is greatly increased by the fact that any person or group of persons with sufficient ready money or credit, can have a ship or ships built and put upon the ocean to compete for the world's carrying trade. There is no expensive lobbying to secure the charter as for a railway, no vexatious and expensive buying of real estate for right of way. Explicit inspection laws make shipbuilding as simple for the investor as housebuilding. The inducement of the great profits that prosperity sometimes brings often tempts the uninitiated to indulge in shipowning ventures, which result in increased depression because of oversupply of ships when prosperity wanes. As a result of the great freedom of competition in rate making and the occasional high profits and consequent rapid increase of tonnage, the shipping business is subject to extremes of prosperity and depression which follow each other in rather rapid cycles.

In this connection a brief sketch of the progress of ocean shipping and freight rates during the past six years will be instructive.


GRAIN RATES
— NEW YORK TO LIVERPOOL
---- NEW YORK TO CORK FOR ORDERS
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
PENCE PER BUSHEL
1
2
3
4
5
6
7

In 1898 and 1899 the commercial world emerged from several years of depression, during which commerce and shipbuilding had languished. Returning prosperity increased the amount of available freight to the point where the existing shipping was unable to carry it. The charter rates, which had been low, now rose to a point of high profit and shipbuilding began with feverish haste. In the midst of this rising tide of the shipowners' prosperity the South African war broke out (October, 1899), and hundreds of merchantmen were recalled from their usual employment and used by the British Government for carrying war supplies. This so intensified the scarcity of shipping that rates rose to a point where the meanest kind of a vessel, either sail or steam, would pay for herself in clear profits within a few years, sometimes even within a few months. Every shipyard in the world strained its energies to meet this great demand. Every place suitable for the laying of a keel was engaged for many months, sometimes as much as two years in advance. But the day of reckoning was to come. By 1902 a large number of new ships had been launched; the British Government was releasing the ships in the transport service; there was industrial depression in Europe, particularly Germany; the great drought of July, 1901, had almost cut off the corn export of the United States and for a similar reason there was no export of wheat from Australia. The combined effect of this sudden lessening of freight and increase of shipping was a surplus of ships. There was not enough work to keep them all busy, but no owner wanted his ships to be the idle ones. If large profits could not be obtained, small ones were better than none; so the rates were cut. Down, down they went to the bare cost of operation and below, because it was better to work a ship for a loss of $20, $50 or $100 a day than to have her lie in port at a loss of $150, $200 or $300 per day. For many months during 1902 and 1903 thousands of tramp vessels, both steam and sail, were a source of constant loss to their owners. In some cases, as that of a large steamer with nothing to do, this loss amounted to hundreds of dollars per day, then for a short period a voyage at less than cost would temporarily reduce the loss. Well might the shipowner who was in August, 1902, carrying wheat from India to England for ten shillings per ton, out of which he must pay Suez Canal tolls, call it a "ruinous figure."

This depression lasted longer than any other within a half century. The accompanying chart shows this clearly. For once fluctuations have been absent because of the dead level of continuous depression. A completed chart from 1866 to 1899 shows fluctuations quite uniform in frequency and degree.[8]

The effect of this depression of rates was a reduction in the value of shipping amounting in some cases to about 50 per cent. In 1900 a nearly new modern freight steamer of 5,200 tons' (dead weight) capacity sold for £65,000. In February, 1904, a 5,800-ton vessel of the same type, condition and speed sold for £33,500, and the depression of the shipowners had extended to the shipbuilders. Three years after the booming prosperity and long waiting lists of January, 1901, there was scarcely a shipyard in any country but had vacant "ways" and found it impossible to secure enough orders to keep all its employees busy, and in many cases this depression reached a stage of acuteness that resulted in financial embarrassments and failures.

2nd. The making of rates for shipments comprising less than a full cargo involves a consideration of (a) line traffic and of (b) the so-called "berth" traffic, which is a sort of compromise between the line and charter traffic.

(a) Rates in line traffic differ at many points from the full cargo traffic, yet they show the working out of the same principles. Competition is nearly always present, and the process of dickering in the bargain for each shipment is common. There is no more uniformity of rate for all the goods on a line steamer at one time than there is for all the many shipments that may fill a train. Valuable goods are charged a high rate and cheap ones a low rate, and different shipments of the same article often have different rates. A line steamer outward bound from an American port usually derives its freight profit from such commodities as machinery and manufactured articles, provisions, oil cake, flour and other prepared food-stuffs. Grain is also usually taken, but at rates that are rarely profitable and always below the full cargo rate for grain. Grain is heavy, but easily handled, because usually handled in bulk, and it makes very desirable ballast to steady the ship. Accordingly the policy is to fill the ship as full as possible with good paying freight and finish her off with grain, some hundreds or thousands of tons, as the case may be. The grain shipper does not especially desire these small and irregular shipments. If the European grain market is favorable at all, it is favorable for a shipload of grain, and if the shipper must ship less he will have a concession in rates. This is the more easily obtained because he knows that the shipowner wants it to serve as ballast. Hence it comes about that the line steamers carry a certain and variable amount of grain at lower rates than the tramps.

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[8] It should be noted that the lower rate on this chart is for small shipments in line vessels, and the higher rate is for full cargoes to British ports.

The fact that the steamship line represents an organized business gives it a tendency to greater steadiness of rates than prevails among the chartered vessels, but if fluctuations do not come as quickly they come as surely on routes where there is competition for the work.

The variety in rates is further increased by the practice of the managers of some lines to make as many long contracts as possible, sometimes for a year or a season, and secure other freight in advance to be taken during a certain month or within a certain week. The year contracts and the month contracts will probably differ in rate, and they are both likely to differ from the rate current at the time of sailing. The last shipments are contracted for in the light of the then existing market conditions, and may be high or low, according to the abundance or scarcity of freight at the time the vessel is finishing out her cargo. If freight is scarce the final rate may be lower than the long contract rates, or if abundant the rate may rise. Freight may be shifted from one line to another so easily that it is actively sought. All the companies engaged in the trans-Atlantic trade have agents in the commercial centers like Buffalo, Chicago, St. Louis, and these agents in turn have their local connections. If freight promises to be scarce for a certain scheduled sailing, telegrams will be sent to the inland agents, or sometimes a personal representative will be sent from New York, Boston or Philadelphia to Chicago or Minneapolis with power to make such contracts as he finds necessary to secure the freight for the otherwise empty space. So it is that competition dominates also in line traffic.

Governments have in no wise attempted by their authority to control ocean rates. Individuals and corporations have made numerous attempts to eliminate competition by agreements among the parties engaged in the particular trade in question. Such a case is the successful shipping ring which has recently been able to control for several years the freight situation for direct trade between Great Britain and India. Individual shippers sometimes avoid its grasp by sending freight by way of Antwerp or other continental ports. One of the two great German lines attempts to hold its patrons and at the same time charge a fair rate by giving, at the end of the year, a rebate of 10 per cent. on all freights paid during the year, provided the shipper has patronized no other line in a German port. This also leads to evasion because the shipper is free to ship via the Dutch or Belgian ports, which handle so much of German trade.

Usually all attempts at rate agreements have failed before they have been of much practical benefit. It is easy enough to maintain them during prosperity and rising rates, but they have gone to pieces in dull times owing to the pressing necessity for income, the lack of satisfactory means of dividing the traffic and the ease of undercutting.

As steadiness of rates is not to be had from unrestrained commerce, nor from the agreements of independent owners, we have recently seen the attempt to control the North Atlantic trade by consolidation. The International Mercantile Marine Company, a combination of great lines, is usually considered to be a result of the fierce and destructive competition and rate cutting that marked the declining traffic and rates of 1901-02. Rival English, American and Belgian lines were placed under one management, and strong financially guaranteed contracts were made with the German lines with the object of controlling competition from that source. The ultimate success of the venture has yet to be demonstrated by experience. As the promoters could not get the Cunard Line into the combination, that company as well as several others may inflict great injury and possible destruction through competition which is now in progress.

Much interest attends the effort of the great corporations to prevent the low extremes that have come from the full and free working of opposing companies. It is claimed by the promoters of this consolidation that the object is not to force rates to a high figure, but to prevent periods of excessively low rates and, above all, to maintain steady and even rates.

(b) The second method of shipping partial cargoes is by the "berth" traffic. This is a sort of compromise between the work of the chartered vessel and the liner, and the rates, like the business, are also somewhat of a compromise. The "berthed" vessel has usually just completed a charter contract, and is sent on a single disconnected and rarely repeated voyage in which she carries freight on the basis of a liner, and makes the rates after the manner of a chartered vessel. A vessel is said to be put upon the berth when a steamship agent in some port announces that if sufficient freight is offered he will dispatch a certain vessel to a certain port at about a certain date. This is more apt to occur at the end of a route, where more freight is received than dispatched. Thus vessels are put upon the berth in Australasia, China, Japan and the Straits Settlements to load for the Atlantic, or in Europe to load for America and occasionally also in the heavy exporting ports to load outward freight. To secure berth cargo in the port of discharge is better than going elsewhere in ballast. If the agents can in a short time make enough provisional contracts to promise success, the announcement is made final and the loading proceeds. The "putting of a vessel upon the berth" is the signal for active bargaining. The cargo is usually made up of many small shipments, and the rates of carriage for the different lots are often made with the same freedom of competition that prevails in the larger operations of chartering vessels. If freight is more abundant than space, the rates are high. If the reverse is true, the rates may decline sharply. The following cases typify the rate making for the berth traffic as it is now carried on. A steamer was loading in Japan for New York. Her agents finding cargo scarce, and rivals plentiful, agreed to take a partial cargo for 20 shillings per ton and depended upon finishing cargo at other ports. At Hong Kong freight happened to be abundant, and the agents were able to secure 30 shillings per ton for the remainder of the cargo—50 per cent. more per ton for a 1,600-mile shorter haul. Sometimes the rate varies for similar goods shipped on the same ship from the same port to a common destination. The ship may be on the berth and loading at a good freight rate, but rivals appear and freight becomes scarce as the time for sailing approaches. Waiting is expensive, and rather than dispatch her with empty space the agents will sometimes contract at the last for a few tons or a few hundred tons at very low rates. Examples are not uncommon where this reduction amounts to one-half of the usual rate, but as it costs no more to carry it than to go without it, it pays the owner of the ship. If two or three ships are loading in the same port for the same destination, the freight rate may rise the minute that one of the ships lessens the competition by weighing anchor to sail. Thus the berth traffic practically repeats upon a small scale for small shipments the free bargaining of charter arrangements.

PART II.—Routes and Shipping.

CHAPTER V.

TRADE ROUTES OF THE OCEAN—STEAMER ROUTES.

The ocean presents a multitude of trade routes. There are hundreds of seaports to which vessels go with greater or less regularly and often from various other ports, and, as between every two ports there is some route that is better than all others, there are hundreds of trade routes passing in all directions across all oceans between the frigid zones and some routes invade even a portion of the Arctic Ocean. All of these routes would scarcely receive attention in an exhaustive treatise, and certainly not in a monograph. They are too numerous for charting on ordinary maps, and only those of importance in world commerce will receive attention here.

The number of ocean routes has been more than doubled during the latter half of the nineteenth century by the use of the steamer. This newer type of vessel rarely followed the older route that had sufficed when wind and sail were the sole dependence of the navigator. The sailing vessel must depend upon winds, weather, currents and tides, and in order to take advantage of these factors it is often necessary to make detours to catch favorable conditions or to avoid the danger of being blown upon the shore. The steamer, with greater power of guidance and always desiring to save time and fuel, goes as nearly as possible in straight lines. Hence the two types of vessels rarely follow the same track, and there are, for a large part of the world's trade, two distinct sets of routes: those followed by steamers and those followed by sailers. This chapter deals only with steamer routes.

In this one class there will be no attempt to describe or enumerate all the routes. For an economic discussion many routes which, from the standpoint of the navigator, are separate, may be grouped under one heading and treated as a unit, as in commercial service they really are.

The routes of the ocean, like those of the land, consist of trunk lines and branches or feeders, which, leaving the main ocean thoroughfares, reach out to the islands or to the ports of the more isolated arms, gulfs and bays that indent the continents. These trunk routes give the real circulatory system through which passes the greater part of the commerce of all nations. The advantage of location possessed by the great routes causes them to draw to themselves through their feeders the great majority of vessels traversing the ocean, but with the sailing routes added to the steamer system the whole sea surface is by no means included as a part of some route.

There are wide stretches of the ocean over which a ship never passes from one year's end to another, unless it be some marine explorer, a wandering whaler or a ship in distress driven from her course by storm or accident. A country as large as England could without interfering with any trade route be located many times over in untravelled seas, such as parts of the Indian, South Atlantic and Central and South Pacific Oceans.

The great basis of international trade is the exchange between the regions producing manufactures and those producing raw materials and food. Western Europe and eastern North America are the greatest manufacturing centers for the rest of the world, and are consequently the starting point or the ending point for the leading ocean routes. Since the leading commercial countries of Europe are on, or adjacent to, the English Channel, that body of water may, in a partly figurative, but almost literal sense, be considered as the origin of European routes and similarly New York Bay of the American routes.

As North America is also the greatest exporter of food and raw materials to Europe, the most important of the ocean trunk routes connects eastern North America with northwestern Europe. Over this great thoroughfare passes regularly more than a sixth of the world's ocean shipping, including the largest and fastest ships afloat.

For convenience we will call this the North Atlantic trunk route. It is not strictly accurate to call it a route, for it is a complex group of routes crossing and paralleling each other and converging to several foci, but they are surprisingly close together in midocean. The Liverpool steamship owners' association declared in an address to the British Board of Trade "that all vessels crossing the Atlantic to this country (Great Britain) from ports in North America take practically the same route from 60° W. longitude." This comes about because of the advantage of following the great circle route, which, curving to the northward, makes all vessels, whether from Halifax, New Orleans or Vera Cruz, follow close to the northeastward-trending coast of America to the Grand Banks off Newfoundland before starting to cross the ocean. During the spring and summer months a somewhat more southerly track is followed, owing to the floating ice, and for this reason the St. Lawrence steamers are compelled to pass to the south of Newfoundland. During the ice-free part of the year, from September to April, the compact sheaf of routes is somewhat scattered, and for a short time steamers pass down the St. Lawrence and to the north of Newfoundland with a considerable saving in distance.

These northern routes are so much shorter than the direct following of the parallels of latitude, that the route from Liverpool direct to Greytown, Nicaragua, is only 323 miles, one day's moderate steaming, shorter than the route by way of New York. Norfolk is a common coaling port for vessels passing from the Gulf of Mexico to Europe.

Next to the North Atlantic in importance is the Mediterranean-Asiatic trunk route, passing from the Straits of Gibraltar around the continent of Asia to Japan. This route, the great thoroughfare between the east and the west, has many feeders east of Gibraltar, and double termini in the Atlantic, one in the region of the English Channel, one in America, chiefly New York, but partly also in the Gulf of Mexico. As it skirts the coast of Eurasia it is fed by a branch from every bay that indents that great land mass, and by other branches from Africa, the East Indies and Australasia. Important contributions come from Barcelona in Spain, Marseilles in France, Genoa and Naples in western Italy, Venice and Trieste on the Adriatic, Smyrna and Piraeus on the Ægean, Constantinople, Odessa and Batum on the Black Sea. At Alexandria the commerce of Egypt is received and at Aden a part of the trade of the Persian Gulf, East Africa and Bombay, the main line going on to Ceylon and Singapore. At Colombo vessels for Calcutta, Madras and Burmah turn northward into the Bay of Bengal and the Australian mail steamers turn southward across the Indian Ocean; at Singapore the route, rounding the corner of Asia, sends a branch to Java and on to Torres Strait and east Australia, receives the traffic from Siam, Tonquin, the adjacent East Indian Islands and some from Manila. The main route passes on to Hong Kong, Shanghai and Yokohama; Shanghai being the branching-off point for the trade of Vladivostok, Port Arthur, Tien Tsin and other ports in North China and Korea.

This great route from the west to the east is the creation of the Suez Canal. Before the opening of that gateway of the seas it was entirely unprofitable for steamers to engage in the trade between the Orient and the Atlantic. The trade was then comparatively small, and the greater part of the present traffic is the creation of the new route.

The South African trunk route is not such a coasting route, nor is it so well supplied with feeders. The peculiar shape of the west African coast, and the scattering character of its commerce, have brought about a duplication of ocean routes in the Atlantic west of Africa. The coasting and local route follows the coast, settlement by settlement, from Morocco to German Angola. The more important route, the South African trunk route, sweeps boldly around the continent to Cape Town, with occasional stopping of ships at the Cape Verde Islands for coal. At Cape Verde, or to the south of it, two branches unite to form the route, one connecting with the English Channel, one with New York Bay. East of the Cape of Good Hope, the vessels in the African trade stop at the British South African ports of Port Elizabeth and East London, most of them continuing to Delagoa Bay, but rarely farther. A few pass up the east coast of Africa. African ports are, however, the destination of but a part, less than half, of the vessels traversing the South African trunk route. The others go directly to Australia and New Zealand, often without touching Cape Town. From the United States to Australia the Suez Canal route is practically as long as the Good Hope route, and all the vessels naturally follow the cheaper and more open route around the continent. From England the saving by canal is about a thousand miles, not enough to make its use profitable for any but fast passenger and mail ships. The purely freight lines from Europe use the South African trunk route. The more important lines steer directly from South Africa to Adelaide, Melbourne and Sydney, and sometimes go on to Brisbane. Less important ones run directly to Freemantle, West Australia, to New Zealand or to New Zealand via Melbourne or Hobart (Tasmania).

The South American trunk route sweeps around the two longer sides of that continent from Cape St. Roque to Panama and on up the coast of America to British Columbia. Like the other trunk routes it is fed from two sources, Atlantic North America and Europe, the two parent streams uniting at Cape St. Roque. The greatest sources of traffic for this route in eastern South America are the Brazilian coffee from Rio Janeiro and Santos, and the grain and animal products of the La Plata ports. Many vessels, devoted only to the trade of the west coast, call at east coast ports only for coal, but discharge and receive cargo at many ports upon the west coast between Valdivia in southern Chile and Guayaquil, Ecuador. A few steamers continue this semi-coasting trade along the coasts of western Colombia, Central America, Mexico and the United States to San Francisco. Other steamers round the continent of South America, but have no South American trade. One New York line engaged in the American coasting trade, calling for coal only at Coronel, Chile, steers directly across the Pacific to San Francisco or Hawaii, according to the demands of freight. Sometimes the service of this line is extended to Portland and Puget Sound ports. Since 1901 a number of steamers have sailed from the Pacific ports of North America for European ports without doing a coasting trade en route, but all steamers in this trade are an innovation in a trade that has belonged exclusively to the sailer.

At Magellan Strait the traffic of this route is swelled by vessels in the New Zealand trade, particularly those returning loaded toward Europe. With this exception, the South American trunk does not receive long branches or feeders as does the Mediterranean-Asiatic in rounding the continent of Asia. The difference is more apparent than real. The Asiatic route skirts the heads of peninsulas, and is often hundreds of miles from the ports lying at the heads of the seas indenting the coast. The branch routes to these ports are evident. The coast of South America is so even that any steamer passing around the continent passes comparatively near to all the ports. The real effect of branches is preserved by the division of the territory among the steamer lines. Some call at the ports of one section of the coast and have no freight connection whatever with other districts. Some lines of west coast South American steamers are as separate from the other traffic of the South American trunk as the Calcutta or Zanzibar steamers are separate from the remaining traffic of the Mediterranean-Asiatic trunk.

The region, called by the Germans the American Mediterranean, has three main inlets: one in the Florida Straits, between Florida and Cuba; one in the Windward Passage, between Cuba and Hayti; and the third at St. Thomas, east of Porto Rico, at the head of the curve by which the Lesser Antilles bend southward and connect the Greater Antilles and South America. The passages near Guadaloupe and Barbadoes are also used. All of these inlets are frequented by vessels from New York and Europe, and the Windward Passage is on the route from New York to Panama and the proposed canal.

The location of the islands and the surrounding mainlands divides the ports of this part of the world into two natural circuits, one in the Caribbean, one in the Gulf. These circuits are followed by vessels in the general trade, and direct routes are followed by the vessels engaged in the special trades. The Caribbean circuit is followed by several lines of vessels. The ports of call are not the same for all lines, but the following ports are well served by vessels usually entering from the east: Guadaloupe, Barbadoes, Trinidad, La Guayra, Cartagena, Colon, Port Limon, Greytown, Kingston and St. Thomas. The Gulf circuit usually includes Havana, Progreso, Vera Cruz, Tampico and Galveston or New Orleans. The special trades are fruit, iron ore and sugar, all of which usually go in full cargoes; the first because of economy of time, the last two because of economy of cost. The iron ore is from Santiago, Cuba, the sugar chiefly from Cuba, and both reach their principal market in the eastern United States, being shipped to Baltimore, Philadelphia, New York and Boston. The fruit trade (chiefly bananas) is more widely distributed. From eastern Honduras fruit steamers ply to New Orleans; from Costa Rica, Colombia and the Greater Antilles to the leading Atlantic ports of the United States; and from Jamaica direct to Bristol, England, and occasionally to Liverpool, Manchester and Glasgow.

The trade routes of the Pacific are of less importance than those of the Atlantic, although their rapid rise in traffic suggests their future importance. But despite the riches upon its shores, the Pacific may well be called a waste of water. Only upon or near its margin will great and promising trade routes arise, leaving its vast center to silence and to routes of secondary importance. It is difficult to realize that this one ocean embraces nearly one-half of the entire surface of the globe, that between the mainland of the American continent at the equator, in Ecuador, and the opposite mainland of Asia, near Singapore, lies the distance of twelve thousand miles or 175 degrees, almost half the distance around the world. Between these two equatorial points upon the spherical surface of the globe there are three connecting lines of practically equal length, one following the equator directly across midocean and two following the meridians (great circles) and passing respectively through the north pole and the south pole. As steamer routes follow great circles, the great size of the Pacific causes most of its routes to avoid its middle and skirt its margin, rather than to steer boldly across as in the Atlantic. Between the north and the south the great circles cross the middle of the ocean, but there are few lands upon the north and south for routes to reach, and routes from east to west following great circles keep in high latitudes near the margin of the ocean to secure their shortest courses.

The heaviest commerce in the Pacific waters passes up and down the coasts of East Asia and of South America, bound for the exits at Singapore and the Straits of Magellan. By far the most important route entirely upon the Pacific is that connecting North America and Asia, the American-Oriental trunk route. Like the North Atlantic route this is a composite one, and not so compact because of the irregularities produced by the calls of some lines at Hawaii, two thousand miles below the line of shortest passage between Puget Sound and Yokohama. It is, nevertheless, proper to consider the North Pacific lines as one trunk route, since all the different courses are close together at the American end, and converge at Yokohama and follow the Asiatic coast to the ports of China or the Philippines. One line now sends steamers to Manila directly from Yokohama, having them call at Hong Kong and Shanghai on the return. It is probable that other lines now sailing no farther than Hong

Kong will, upon the increase of Philippine industry, extend their service by making Manila the final destination. On the American side the routes originate at six places: Manzanillo, Mexico; San Diego, San Francisco, Portland and Puget Sound, and before many years there will probably be other American ports added to the list. There are now lines of vessels starting from San Francisco and San Diego, and calling at Honolulu, although it lengthens the voyage from the first city more than eight hundred miles. From all of these six starting points vessels also go directly to Yokohama, and usually by the northern or great circle route. From Puget Sound it is impossible to follow a perfect great circle because of the Aleutian Islands, within sight of which the vessels pass in good summer weather. In the winter it is the practice of some captains to steer straight across the ocean or even to go south of the direct route to secure more favorable winds and weather. The great circle route is the one most commonly followed, unless calling at Hawaii, and from all points on the American coast including Panama this, the mathematically shortest route to any point in Asia, follows the coast line to California, passes close to San Francisco, closer to Puget Sound than to Hawaii and thence northward to the latitude of Alaska before turning south and skirting the shore of Japan.

A route of less importance and far less promise than the Oriental is the Pacific Coast-Australasian, the last of the steam trunk routes. This route, like the preceding, is composite and more definitely spread out than any of the other trunk routes. On the east is the course followed by the line plying between San Francisco and Auckland, New Zealand, via Tahiti, Society Islands; on the west that from Vancouver to Sydney via Honolulu and Fiji Islands. By a branching of the route at Honolulu, San Francisco is connected with Sydney, and by other branchings at Fiji and Samoa, British Columbia is connected with New Zealand.

This route across the Pacific has been found by experience to be the quickest mail route from Australia to Europe.

The weather in the Pacific is usually reliable and favorable, and when the mail has reached San Francisco by direct steamer, it has the advantage of the fastest long-distance train service in the world to New York, and thence to Liverpool the fastest steamship service in the world. In competition with this is the route followed by the slower steamers crossing the Indian Ocean, the Red and Mediterranean Seas and delivering the mail to the railway only at Brindisi, Italy, whence it crosses the Alps to Paris and London, with several days saving of time.

There are two reasons why the Pacific Coast-Australasian route lacks great promise for the future. The first is that the climate and resources and stage of present and prospective industrial development of Australasia and the Pacific Coast of America are too nearly alike to give the natural basis for any extensive exchange of products. They are more nearly rivals than economic complements. The other reason for the secondary rôle of this route is that it now serves partly as the outlet for the region to the east of the Rocky Mountains, and the Panama Canal will in a few years compete heavily for that trade.

This brief presentation of the world's steamer routes makes no pretence of being full or complete, but only to point out the main arteries of world commerce, leaving the minor tributaries and distributaries to be worked out by those who may have a special interest in the subject.

The avenues of commerce have been divided off into routes having separate names, but it should not be thought that each is separate from the others. The divisions have been made in part for convenience of description, for the routes are not entirely separate, but connect and overlap at various points into a unified system encircling the world.

No trunk route with its branches can be considered as an independent unit of circulation with vessels limited to it, and going and coming in even procession with equal numbers inbound and outbound. As no country imports and exports equal quantities of freight, so no route has similar amounts of freight or the requirement for equal numbers of vessels going and returning. It is usually but not always true that the line steamers go and return by the same route. The irregular element is chiefly furnished by the chartered vessels or tramps which depart from the trunk routes at ports where more freight is imported than exported. They go seeking freight, and join other routes at ports that ship more freight than they receive. By this process the South African trunk route is a heavy loser, and the South American and the Mediterranean-Asiatic are gainers. South Africa imports coal, flour, lumber and general manufactures and supplies—all of them being heavy and bulky articles. The leading exports are gold and diamonds, requiring no space worth mentioning. South Africa is, therefore, a dispersing place for vessels charged with ballast and seeking freight. Some go to India for grain or jute, others to Burmah for rice, others to Java for sugar, some to Buenos Ayres for wheat, some are even compelled to go to the United States.

In Australia the same conditions are repeated. This commonwealth imports iron, lumber and general manufactures and exports wool, hides and meat, all of them several times as valuable per ton as the staple imports. Sometimes there is a small export of wheat, but there is usually a large surplus of shipping that must fall back upon coal, which fortunately Australia possesses at Newcastle, sixty miles north of Sydney. With this cargo many vessels go to East Indian and Oriental ports—Batavia, Sourabaya, Singapore, Manila, Hong Kong. After discharging the coal they can sometimes reload directly, but often another though shorter ballast voyage must be made to secure a cargo of Java sugar, Manila hemp, Siam or Burmah rice or even Indian jute, grain and seeds. From Newcastle other vessels, usually sailers, depart to Hawaii for sugar, or to San Francisco, Portland or Puget Sound for wheat. Others, both sail and steam, carry coal cargoes to northern Chile for nitrate of soda. By these various routes a large proportion, possibly a half, of the vessels that go out on the South African trunk route return to the North Atlantic by another way.

China and Japan are likewise countries with a surplus of outgoing shipping, and Japan is an exporter of coal that is in common use as far south as Singapore, and it is sometimes sent to Hawaii and the Pacific Coast of the United States. The surplus shipping of East Asia usually seeks cargo in the Philippines, Java or United States; some vessels crossing the North Pacific and transferring themselves from the Mediterranean-Asiatic trunk to the South American by way of the American-Oriental.

Triangular voyages are often made in these transfers from route to route. There is such a one in the North Atlantic.

Brazil exports coffee very largely to the United States, and as the return cargo is light, many of the coffee ships load in American ports for Europe and return thence with European goods to Brazil, completing a triangular voyage. Voyages of a triangular character are often made by tramp vessels, and many of them can be figured out from the examples given above, but none of the many triangular voyages are so plain, so unobstructed and so nearly equilateral as the Atlantic triangle.

CHAPTER VI.

COAL SUPPLY AND COALING STATIONS.

The coal supply and coaling stations are topics of prime importance to maritime commerce. Steam has encroached upon sail until, at present, over nine-tenths of the ocean work is done by steam-driven vessels, fed almost exclusively with coal. This dependence upon coal makes the coal supply one of the most important questions connected with the management of shipping and the selection of routes. It is entirely possible that some revolutionary invention may displace coal as a source of power, and cause the importance of coaling stations to decline as suddenly as it arose. For the present, however, the coal problem occupies a position of unchallenged importance.

As was pointed out in the chapter on the charter traffic, the distribution of coal among the world's coaling stations is largely a by-product of the charter traffic. Owing to this dependence the coal secured by ocean steamers away from their home ports is originally derived from a surprisingly small number of places. The great bulk of it comes from Wales, some from eastern United States, Australia, Japan and small quantities from India, southern Chile and the Puget Sound district of United States and Canada. Another result of the distribution by charter vessels is the relative cheapness of coal near centers of production of general commercial products, which give return freights to coal-carrying vessels.

Prevailing Freight Rates for Coal, March 16, 1904, from Wales to

Algiers	$1.40	Colombo	$2.40
Constantinople	1.38	Santos	2.52
Port Said	1.32	Buenos Ayres	1.92
Aden	2.28		

Prices of Welsh Coal from Hull, Blyth & Co.'s Coaling Contracts for 1904. Prices in Shillings.

Gibraltar	22	Santos	40
Constantinople	22	Montevideo	30
Naples	19½	Buenos Ayres	28
Bahia	38½	Cape Town	44
Rio Janerio	33½	Mauritius	41

Examination of the above table of coal freights shows that the rate bears little relation to the distance; that to Buenos Ayres being lower than to Santos, which is nearer; and that to Constantinople, near the Black Sea grain and oil ports, being a little less than to Algiers, which is about half as far, and on the same route. In the table for coal prices we see the same factors making striking differences among the five South American ports mentioned, Brazilian coffee and Argentine wheat being the causes of variations. Cape Town, with no return cargo, has coal more than 50 per cent. higher than Buenos Ayres, although about equally distant from Wales. Mauritius, located in the Indian Ocean, far beyond Cape Town, has sugar to export and coal cheaper than Cape Town. These peculiarities of distribution are factors of great importance and universal application in the development of coaling stations.

In deciding what shall be his coaling stations for a particular voyage or a particular route, the manager of steamers must consider several factors which may give different results under different commercial conditions, for there is a rather surprising degree of option and variety of choice open to the man who considers this question. The resultant decision is a neat balancing of profit and loss factors. 1. Comparison must be made of the advantages of carrying much coal or much freight. 2. Port charges due to entering ports. 3. The distribution of possible stations and the longest link in voyage without coal.

1. If the route offers the possibility of coaling several times along its course, as almost all long routes do, shall the steamer stop frequently for coal and carry the greatest pos-

sible freight cargo or shall she carry less tons of freight and more tons of coal from the most favorable places for coal purchase? That question is answered by comparing the profit derived from carrying the extra tons of freight, with the loss from buying en route the extra tons of coal that are made necessary. The changing price of coal and the changing profits from freights, and the difference in coal price at different stations, make this a fluctuating balance. If the profit in carrying a ton of freight from New York to Australia is $5 per ton, and the loss in purchasing coal at Cape Verde rather than New York is $4 per ton and at Cape Town $8 per ton, the steamer will probably coal at Cape Verde and pass Cape Town. If the freight profit drops to $3, and the Cape Verde coal margin remains at $4, the coal will most likely be secured at New York for the entire voyage. Decisions of this character make constant fluctuations in coaling practice. The steamer bound from New York to China may secure an extra lot of paying cargo at the last moment, making it necessary to coal at the Azores and frequently beyond. If the freight is not so abundant the first stop may be at Algiers, and the number of coal stops for the voyage will be less. There are times when regular Oriental liners steam from Liverpool to Japan without coaling en route.

2. The costs of stopping are always a deterrent from making frequent coaling stops. A stop means the loss of valuable time, and it may mean the payment of harbor dues, wharf dues, quarantine and pilotage, one or all. These charges materially increase the real cost of the coal.

The above-mentioned factors contain a large element of choice, but this is usually lacking in the third.

3. The longest break without the possibility of coal may decide the amount of bunker space that must be left, and unless way freight can be taken for intermediate ports, that longest break will decide the coal space and make it profitable to carry coal past good coaling stations that may be closer together. The steamer route from New York to San Fran-

cisco is an illustration. From southern Chile the steamers, after coaling at Coronel, steer directly across to San Francisco. The coal space necessary for this part of the voyage will hold enough coal to bring the steamer out from New York to Coronel without stop at any port of eastern South America.

As a result of the conditions affecting the coal supply and its distribution, there is a decided tendency to supply steamers as near as possible to the source of the coal. This is much less true of express steamers making a specialty of speed, than it is of the purely freight service. By coaling at the home port the purchaser avoids the payment of coal freight and is, in a measure, his own freight carrier. The coal merchant in the Mediterranean or West Indies must buy the coal in Cardiff, Philadelphia or Pittsburg or Norfolk, pay the out-freight and then receive a profit on both transactions when he sells to passing steamers. If the shipowner buys in the original coaling port he can secure it as cheaply as the merchant, and save the profit made by the latter. This reasoning explains the common practice of the owners of vessels plying between the cities of the United States and the West Indies, and England and the Mediterranean. The steamers usually set out with enough coal to last for the round trip, and purchases are made en route only under unusual circumstances. More pronounced examples of this avoidance of intermediate stations will appear in the discussion of the coal supply along the principal routes.

The great ocean trunk routes differ widely in their dependence upon and their supply of coaling stations.

The Atlantic North trunk has no coaling stations except those at the eastern and western ends. Fortunately for the commerce on this route there is an abundant coal supply at each end, and in times of disturbance in coal production and supply, the line steamers are able to secure enough coal at either end to run them on the return trip. Under ordinary conditions American coal is used going east and European going west. Most of the coal for the European supply of steamers comes from England, even though the vessels are running to continental ports.

It is quite common for European steamers plying to ports in the Gulf of Mexico to coal at Norfolk, Va., on the return voyage. This is the port of shipment for the Pocahontas coal, than which there is no better for steaming purposes.

The Mediterranean-Asiatic trunk has an exceptionally favorable chain of coaling stations scattered at convenient intervals along its route. Steamers dispatched from America pass within sight of the Azores, where the port of St. Michaels offers a good coaling station. Then come Gibraltar, Algiers, Malta, Port Said, Aden, Colombo, Singapore, Hong Kong, Shanghai and the chief terminus, Yokohama, lying near the Japanese coal fields. This route has, in addition to the frequency of its stations, several causes making coal cheap. It is produced at both ends of the route, and cheap freights distribute it along the route. Freights are low to the Mediterranean because of the export freight furnished by Black Sea grain, Sicilian sulphur, and the exports of Egypt. India has a heavy grain export, which has made cheap import coal, but in recent years the mining of Indian coal has almost stopped the import of this commodity. Coal is drawn to Singapore by the possibility of out cargoes of Java sugar or Asiatic rice, so that in this market the shipper can buy Australian, Indian, Japanese and sometimes Welsh coal, and passing steamers are almost invariably supplied here. Of equal importance as a coaling station is Port Said. Algiers and Colombo are next in importance and but slightly less frequented. Algiers is popular with the American lines, while some of the British call at Gibraltar. St. Michaels, Azores, is also frequently used as a point of supply for American vessels, particularly in times of prosperity among shippers, but the American vessels oftener go on to Algiers for the first stop. Many vessels coal at Aden, but this port is less used than the rest, because lying, as it does, between two desert regions, coal is high and passing steamers are often supplied at Port Said, so that they can pass on to Colombo and even Singapore. As mentioned above, vessels sometimes use the route without coaling at all.

The South African trunk route offers a strong contrast to the Mediterranean-Asiatic. The available ports are fewer, no coal is produced for export along the route and there is no surplus of exports to make coal importation easy. The nearest sources of supply are Australia and England, each more than five thousand miles distant from South Africa, the natural location for a great coaling station. St. Vincent, Cape Verde, is, however, used much more than Cape Town. The latter city is used only by vessels in the African trade, those to Australia pass the Cape of Good Hope without stopping and many do not stop at Cape Verde. In cases of emergency, Albany, West Australia, is a convenient port, but steamers usually go directly to Adelaide, Melbourne or Sydney. This last city, the metropolis of Australia, is near the coal mines, is the greatest coaling station of the southern hemisphere and is visited by nearly all steamers that go to Australia. The island of St. Paul lies in the southern Indian Ocean, almost on the track of the Australian steamers, and it has a good harbor, but no use is made of it and the island is uninhabited.

In the trade along the west coast of Africa, which is nearly monopolized by lines from Liverpool, Hamburg and Antwerp, the usual practice is to carry coal from Europe to last both ways.

The South American trunk route is well supplied with coaling stations throughout the greater part of its length, and has the great advantage of a local coal supply beside the sea in southern Chile, latitude 38° S. The heavy exports of Chilean nitrate and Argentine wheat do much to facilitate the importation of coal for the central part of the west coast. The stations are well distributed. Steamers from Europe pass Madeira, the Canaries and the Cape Verde Islands, those from the United States pass near the outer West Indies. After reaching Cape St. Roque, the route passes close to Pernambuco, Rio Janeiro and Montevideo on the east; Punta Arenas on the Straits of Magellan, and a succession of ports on the western coast, of which the most important are Coronel, Valparaiso, Iquique, Callao, Guyaquil and Panama, Acapulco and San Francisco. As is the case on the Mediterranean-Asiatic trunk, the ports are not equally used as coaling stations. Line steamers from New York to Buenos Ayres often aim to carry enough to last them back to New York, and if they run short, supply themselves at St. Lucia in the Lesser Antilles. Line steamers to the west coast often go directly to Coronel, as do the San Francisco steamers. Nitrate steamers are supplied in the nitrate ports, Autofagasta and Iquique, chiefly with Australian, but also some Welsh coal. The bunkers are usually replenished at Coronel, Montevideo and St. Lucia, or at St. Vincent, Cape Verde, if the destination is in Europe.

The trade routes of the West Indies and the Caribbean are abundantly supplied with coaling stations in the multitudinous ports of that region, but a comparatively small amount of coaling is done. The direct lines from the United States usually carry enough coal to last both ways. For the British lines the distance is too great, and they usually take on coal at some West Indian port. St. Thomas, lying on the northeastern passage to the Caribbean is probably the most important of these coaling stations, with Kingston, Jamaica and Havana next in importance.

The Pacific, the largest and widest of the oceans, has a multitude of islands dotting its surface, but none of them are coal producers, and surprisingly few coaling stations have developed among them. This is to be explained by the high price of coal upon small islands, and by the additional fact that each of the four continents bordering upon the Pacific has a coal-producing area near its shores: New South Wales in East Australia, Chile, Japan and the Washington and British Columbia field. Each of these districts is on or at the end of a trunk route, and between them they are able to supply most of the coal used in the Pacific. Yokohama, Osaka, Moji and Nagasaki are the chief Japanese coaling ports, and the terminal ports perform that service in America. The only coaling station of importance away from the mainland is at Honolulu, Sandwich Islands. Some of the lines passing over the American-Oriental route stop here for freight, but it is not a regular practice for them to secure coal at this port. Steamers in the North Pacific trade usually run from Japan to the mainland of North America without coaling, and most of them without stopping. Those following the great circle route pass close to or in sight of the Aleutians, but coal is never taken in this region, although the Aleutian port of Dutch Harbor is used as a coaling station by the Behring Sea traders.

The coaling practice on the Pacific Coast-Australasian route is quite similar to the above. Calls are made at Honolulu, Samoa, Fiji and Tahiti, but the steamers usually start with enough coal to carry them for the whole breadth of the Pacific.

In this chapter no attempt has been made to give a complete list of the world's coaling stations. As with the ocean routes, only the most important have been referred to. There are hundreds of lesser trade routes and coaling stations that are not of sufficient importance in international trade to merit discussion in a work of this character. Every port having lines of local steamers is likely to have coal for their accommodation. The minor or so-called outports on the routes of coasting steamers, such as those along the western coasts of Africa or South America, often have limited coal supply, although it is not regularly called upon. Ports from which tramp steamers occasionally depart are also stations where coal may usually be obtained. These lesser ports, however, do but an insignificant share of the total coaling traffic. The most of it takes place at the comparatively few important stations upon the trunk routes. In some seas coaling stations of minor grade are very numerous. On the Pacific Coast of South America, coal supplies were kept in 1901 at thirteen of the twenty-five ports of call for European and American steamers. On the shores of the West Indies, the Caribbean and the Gulf of Mexico there were forty-three coaling stations. The Mediterranean possessed seventy-nine, the Black and Azof Seas fifteen, the Atlantic Coast of the United States seventeen, of Canada and Newfoundland twenty-six.

The statements made in this chapter are not made with reference to war vessels. With this type of craft questions of economy and cost are minor considerations, and coal is commonly taken wherever its location is most convenient.

The facts here given concerning the numbers of stations are taken from the United States Navy Department's coaling station map, a publication which has, unfortunately, been discontinued, owing to the difficulty of keeping the information properly revised.

CHAPTER VII.

TRADE ROUTES OF THE OCEAN—SAILING ROUTES.

The location of sailing routes differs from that of steamer routes because of the different methods of navigation. With the steamer every mile covered costs a certain coal consumption, so that the steamer routes, reckoned in miles, are almost always the most direct routes possible, deviations only being made to avoid rocks, ice, thick fog or very stormy locations. The steam navigator thinks of his voyage in miles because distance is the chief factor, but the sailing captain reckons his voyage by days because the varying winds may take his ship one mile or two hundred miles in a day; or, again, headwinds may make it necessary to "tack," or sail from side to side, so that two hundred miles of sailing means but one hundred miles of progress. So it is that sailing routes are decided not by the shortest lines, but by wind and other conditions over the seas traversed.

The force and regularity of the wind differ greatly in different parts of the ocean, and to avoid regions of calm or of low winds or headwinds, the sailing routes often make wide detours in midocean, and owing to the peculiarities of a sailing ship these vessels rarely go to and fro between two given points by the same route, because the wind that speeds the departing, retards the returning vessel. Further than this, the winds in many parts of the world change with the seasons, and the sailing routes of winter are different from those of summer. Owing to the lessened certainty of location and lack of freedom along coasts, sailing routes do not lend themselves so easily as steamer routes to a classification into trunk routes and branches.

Where such classification is possible it is decided more by wind influence than by common destination, and it is better to consider the routes with regard to the location of all routes in each particular ocean rather than with regard to destination and origin of each particular route. The location of a sailing route depends upon so many different natural phenomena that all those in a particular ocean should be described at one time, because their location reflects the general climatic conditions of the ocean.

If such use of terms is permissible, it may be said that the sailing routes are more oceanic than the steamer routes because the sailing captain studiously avoids the vicinity of coasts and closed or narrow seas. The dangers of sailing are increased as the land is approached, and the coasting trade, with its frequent entering and leaving of ports and following of coasts, is not attractive to the owners of sailing ships. The Suez Canal is not used at all by sailers passing between North Atlantic and Oriental ports, because of the light winds of the Mediterranean, and the still lighter and more uncertain winds of the narrow and rocky Red Sea. All sailing vessels passing between the North Atlantic and the Pacific or Indian Oceans, almost all of those engaged in the sailing traffic, are compelled to traverse the length of the Atlantic, and the routes are decided by the prevailing winds which are a part of the general atmospheric circulation of the earth. An explanation of this circulation is essential to an understanding of sailing routes of all oceans.

The combined influence of the motion of the earth and the different temperatures in different latitudes produce a general wind system upon the surface of the earth and with increased regularity upon the oceans. This is studied by the sailing captain as carefully as the coal question is by the owner of a line of steamers. The winds are most regular and reliable in the hot latitudes. That part of the torrid zone receiving the most direct rays of the sun gets hottest and is a region of calms because the highly-heated air is rising. This rising air of the zone of calms is replaced by the air that blows in from north and south, the trade winds, which sweep regularly over the torrid zone and are deflected from north and south winds to northeast and southeast winds by the earth's rotation toward the east. In some regions, particularly off the coast of Spain, the trade winds extend to a considerable distance north of the tropic, but this is unusual. Owing to the apparent northward and southward motion of the sun, the zone of the trade winds also moves several degrees north each summer and south each winter. For the southern hemisphere the direction of these seasonal movements of the southern trades should be reversed. In the temperate zones the prevailing winds are westerly, though not so constant as the trade winds, being more liable to disturbance by cyclonic storms, during which the wind blows from all points of the compass in turn.

The sailing routes of the Atlantic illustrate in a striking manner the effects of the prevailing winds. Between the northern states and the English Channel the sailing vessel goes before the westerly wind and follows closely upon the steamer route. Returning there are two routes, a southern and a northern. The northern faces the west wind and involves much tacking back and forth. The southern route going southwest to avoid the westerly winds and get into the trades, passes along the coast of Spain, south of the Azores and Bermudas, and, crossing in the latitude of Havana comes up northwestwardly to the middle Atlantic states. If the destination is the Gulf of Mexico, the vessels go still farther south, passing into the Caribbean near Barbadoes and out through the Yucatan Channel into the Gulf. In the winter this southern route is made even longer because the vessel must go farther south to reach the trade winds. Even the vessel bound for New York may then go one hundred and fifty to two hundred miles south of the tropic of Cancer. At this season the seas east and north east of Newfoundland are more favorable to ships because free from ice.[4] and vessels returning from North Europe follow the northern ✓

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[4] The icebergs and ice floes are released from their frozen moorings by the summer thawing and float about the ocean during summer and autumn. The solid freezing of winter holds the next ice crop in place until the succeeding June.

route. From the North Sea they go around Scotland, those from the Channel steer northwest from the Scilly Isles or southwestern Ireland, till latitude 54 degrees is reached, then from midocean a southwesterly route is followed along the coasts of Newfoundland and Nova Scotia. This northern detour is taken to avoid the strong headwinds and storms which often rage during this season with great fury between 45 and 50 degrees north.

The most important sailing routes of the Atlantic are those leading to the other oceans by way of Cape of Good Hope and Cape Horn. The inbound and outbound tracks differ, and there are also the seasonal variations, but these sailing routes are more deserving of the name of trunk routes than any others in the world. The equatorial section of the outbound route is followed by all vessels from both Europe and America destined to the coasts of the five continents bordering upon the Pacific and Indian Oceans. The inbound routes to Europe and America are not at any time united so completely, although they have some of their divisions in common.

The outgoing routes converge in the equatorial section because they cannot safely pass Cape St. Roque without going with the trade wind that blows from the Canaries directly toward the point of South America. European vessels have a direct route from the English Channel till they reach the trade winds off the coast of Spain or Morocco.

The vessels from the Atlantic Coast of the United States would be delayed by the trade wind if they sailed directly toward Brazil. The quicker way for them to reach Cape St. Roque is to go with the west wind eastwardly across the Atlantic toward the Azores, then turn south and go with the trade wind. This route joins the European near the equator. From this point southward to the tropic of Capricorn vessels bound for the Indian Ocean proceed directly south to avoid the southeast trade and catch the prevailing west winds which carry them across the South Atlantic to Cape Town and into the Indian Ocean. A part of the southeast trade is deflected toward the southwest along the slanting coast of Brazil. To take advantage of this wind and a similarly deflected equatorial current the route to the Pacific separates from that to the Indian Ocean opposite Pernambuco and follows the coast, passing inside the Falkland Islands and around Cape Horn.

The inbound routes of the Atlantic are everywhere in different locations from the outbound. In returning from the Indian Ocean the southern west winds are a hindrance and the navigator keeps as close to the Cape of Good Hope as possible, and sails northwest into the trade winds and on toward the equator. The American and European routes from the Indian ocean diverge from the Cape; the first-named going almost directly to New York, thus crossing the northeast trade at a right angle, and having nearly the same angle to the Gulf Stream and the prevailing westerly winds north of Bermudas. The European routes in crossing the northeast trades are driven so far to the west that they enter the zone of westerly winds in the longitude of Eastern Brazil and Greenland, and, passing to the west of the Azores, approach their destination from a westerly direction.

The captain sailing around Cape Horn into the Atlantic desires to avoid the coastal wind and current that carried his ship downward and inside the Falkland Islands. Inbound, he steers far to the east of the Falklands, keeping in the prevailing west winds as long as possible, and then borne onward by the southeast trades makes a gradual curve toward the equator at midocean. If the destination is America, a northwesterly route is taken at 10° S., and north of the equator, the routes to American and European ports are similar to those from the Indian Ocean, described above.

The trade routes of the Pacific are shaped by the same forces that operate in the Atlantic. The effect of the prevailing winds is distinctly marked in the north and south routes. Northward from Cape Horn vessels run comparatively close to the coast and directly across the course of the west winds. When the ships bound for the Pacific Coast of the United States reach the southeast trade they follow it to the equator, work as best they can directly north across the zone of calms and then at right angles across the northeast trade until they reach the westerly winds, before which they run directly to the land. This last characteristic is much more pronounced in the route from Australia. The remarkable curves in the northern and southern parts of this route giving it the shape of a letter S, are striking evidences of the value to the sailor of the westerly winds of the temperate zones. The sailing route from San Francisco to Cape Horn goes southward with the northeast trade, turns to the west to get a sailing angle across the southeast trade and then below the tropic, gradually swings southeastward to the Cape with the westerly winds. From San Francisco to Australia the route is comparatively direct, going with the northeast trade toward the equator, at a right angle to the southeast trade until close to the tropic of Capricorn, where a turn to the west is made to avoid the westerly winds until as near the Australian Coast as possible.

The most curious of all Pacific routes are those followed between San Francisco and other North Pacific ports and Panama and Callao. Between the equator and Central America, and running west as far as 115° W., is the largest region of calms in the world. At certain seasons there are daily thunder storms and slight breezes that blow a vessel a few miles this way one day and possibly the opposite way the next. There are cases on record of vessels that have beaten about the Bay of Panama and the adjacent ocean for more than one hundred days without making any material progress. South of this zone of calms is the southeast trade. In avoiding these difficulties it is the custom for sailing vessels bound for Central and South American ports to pass far to the west where the zone of calms is narrow, and go around below the trade wind which is a headwind, and then across or with this wind to the port desired. Coming out from these coasts is easier because the trade wind is favorable, but the calms are none the less formidable, and from Panama they must be avoided according to Maury by a southern detour made by beating down the Colombian Coast to the neighborhood of the equator, passing westward by the Galapagos Islands to one hundredth meridian, then northwest toward Cipperton Rock, 10° N. and 109° W., whence the course follows previously mentioned routes to the northward.

In the North Pacific the route from the Orient to North America is like the corresponding route of the North Atlantic, a simple following of the westerly winds. Westward, the vessels drop down into the latitude of the trade winds near the latitude of Hawaii, and sail directly west near the twentieth parallel until necessary to turn off to reach the ports of Japan or China.

Equally simple is the much-frequented route across the South Pacific from Australia to Cape Horn. The west wind enables the ship to sail directly toward the Cape. A great circle route cannot be followed because of the danger from floating Antarctic ice.

The wind system of the northern half of the Indian Ocean is unlike that of the other oceans, because of the disturbing influence of the continent of Asia. This enormous and largely arid land mass lies just to the north of the trade wind zone, and in summer it becomes so much hotter than the ocean to the south of it that the air rising from over the land draws toward the land an enormous southwest sea breeze blowing from the equator toward Asia—directly reversing the trade wind during the summer months. These winds, bearing the name of monsoons, occupy the latitude of the northern trades, and by their force sweep across the greater part of the usual zone of calms, and in the season of the northern summer they exert some influence several degrees south of the equator. The southern part of the Indian Ocean has a normal trade wind at all seasons and the northern part has in the winter months.

The sailing routes of the Indian Ocean, unlike those of the Atlantic and Pacific, have somewhat the form of trunk lines and branches with separate systems inbound and outbound.

The inbound trunk follows the southern margin of the ocean from west to east. On this thoroughfare the navigator takes advantage of the steady west wind as long as possible before turning northward to the ports of Africa, Asia or the East Indies. Australian vessels complete the voyage before the west wind. Vessels turning toward Asia or the Sunda Islands can sail by the trade winds directly north to the vicinity of the equator. Here the course, for points beyond the equator, must change to take advantage of the changing monsoons. The summer route to Bombay passes north close to the east coast of Madagascar, and goes with the southwest monsoon across the Arabian Sea. The winter route, avoiding the full force of the winter (northeast) monsoon, goes northward toward Ceylon and then turning northwest follows the west coast of India at right angles to the wind. The return routes for both seasons follow closely upon the latter route as far as the equator, and then, like all the returning routes of the Indian Ocean, go west southwest across the southeast trade wind to the point of Africa, avoiding the westerly winds as much as possible. The routes to and from Calcutta show the results of exactly the same principles that entered into the location of the Bombay routes. They do not cover so wide an area because the Bay of Bengal is so much narrower than the Arabian Sea. Sunda Strait, the sailers' gateway to the East Indies, the Philippines and the coasts of East Africa, is below the monsoon zone, and has but one approach directly from the south and one outbound route, a direct line to the point of Africa.

CHAPTER VIII.

THE PROBABLE EFFECTS OF THE PANAMA CANAL UPON OCEAN TRADE ROUTES AND COALING STATIONS.

There is no better way to realize the world character of present commerce than to speculate upon the probable changes to result from the opening of a canal across the American isthmus. The effects of this new inlet to the Great Pacific will run through the world's commerce like new gold in the currents of financial circulation. There is no limit to the field of its influence. The trade of all the great nations, and of most of the secondary ones, will be directly affected; every one of the great trunk routes for both steam and sail will become of more or of less importance as a result of the opening of this new highway between the two greatest commercial oceans. It is impossible to fortell with exactness the extent of these changes; indeed, it will be impossible to state them statistically when they have occurred, unless in the interval statistical work of a hitherto unprecedented character is taken up and completed.

Two elements confuse any estimate of the probable use of an isthmian canal: (a) the rate of toll, (b) the improvements in the methods or cost of navigating ships.

(a) The Panama Canal is not, like the Suez Canal, to be the money-making scheme of a private company. Nevertheless, tolls will almost certainly be charged, and, as with all other canals, the rate of toll will affect the extent to which commerce will use the waterway. The question of toll rate is of especial importance in the management and traffic of the Panama Canal, because such a large proportion of its trade might be driven to other routes by high rates of toll. In this respect it is signally different from the Suez Canal. The American canal has four main fields from which and to which its commerce may come and go: Pacific North

America, Pacific South America, eastern Asia and Australasia. Two of these four trade areas are upon the margin of the zone of canal influence. A high rate of toll might drive away completely the commerce of Australasia, most of the South American and, if accompanied by low tolls at Suez, a considerable share of the Asiatic trade might also be lost to the American canal. But a reduction of the Suez rate is highly improbable, because the reasons that prompt to low tolls for the Panama Canal, prompt to high tolls for the Suez. Of the traffic for this canal, a surprisingly small portion is upon the margin of its traffic zone, only the Australasian, and the greater part of that follows the Good Hope or Magellan routes. The great bulk of Suez traffic is bound to or from southern and eastern Asia, and the saving is so great that the shippers can afford to pay high tolls. If the tolls were raised one-third or one-half, nearly all of the traffic would at present continue to use the canal, and if the rate were reduced one-third or one-half there would be but slight gains in tonnage, certainly not enough to make up the loss in revenue.

With the Panama Canal, traffic will fluctuate with the rate of toll. It is possible that as much revenue will be derived from a low rate as from a higher one, because of the greater amount of business done. For example, a rate of $1.50 per ton (net register) would yield, for four million tons, six million dollars. The same income would be derived from $1.00 per ton on six million tons, and there would be a great additional saving to commerce because of the greater number of ships following the shorter route.

In operating the Panama Canal, the United States Government may follow one of three toll policies. The toll may be fixed with the object of (1) paying a profit to the government, in the form of interest on the investment; (2) paying expenses and providing for a sinking fund to cover the cost of construction; or (3) to merely pay operating expenses. The fourth possibility, absolute freedom from tolls, scarcely merits consideration.

The first plan, that of deriving profit, is highly unlikely, owing to the great interests of the American commerce in the canal, and the general policy of the government in making improvements to foster trade. Of the two remaining policies, the third is quite as likely to prevail as the second. In that case 50 cents per ton promises to be adequate to cover all expenses from the very beginning, while the rate of $1.00 per ton would within a short period probably provide for interest payments. Considering the commercial policy and commercial interests of the United States, and the probable deflection of commerce by a high rate of toll, it is not likely that the rate will exceed $1.00 per ton, and it may be much less. The discussion in this chapter is based upon anticipations of a toll of $1.00 per ton, although the possibility of the cheaper toll is not thereby dismissed to the realm of pure speculation.

(b) The use of the canal will be materially affected by any improvements in shipping or conditions in the shipping market which permanently or temporarily affect the cost of running ships. The shipowner will pay tolls to send his ship through the canal because it costs less than to pay operating expenses for a longer voyage around. Improvements may reduce these expenses so that for some shippers there will cease to be profit in using the canal.

Ship expenses may be roughly divided into the following classes: 1. Cost of construction. 2. Interest on the cost, along with insurance, and, at times, a positive profit over and above interest. 3. Wages, including provisions. 4. Motive power, including repairs to machinery and fuel. Each of these four elements is subject to change with the passing years, and some of them to very great change. The steady progress of science and mechanical invention is reducing the cost of construction. The rapidly increasing accumulations of capital are bringing down the rate of interest and the necessary interest charges on a ship. Improvement in ships' machinery is reducing the demand for human labor, lessening the number of the crew and the size of the wage roll. This process has not ended. Well-nigh revolutionary changes in ship mechanism seem to be among the early possibilities, and, as in the past, this will be accompanied by further reductions in the fourth element of cost—repairs and fuel. Ten or twelve years of progress and change along these lines may bring about such different conditions that certain traders now willing to pay a certain toll at the canal, will then find it more profitable to go around than pay that toll.

Similar relapses in canal traffic are likely to be produced temporarily by periods of great depression in the shipping business. As has been pointed out in the chapter on charter traffic, these crises go to surprising extremes, entirely wiping out profits and interest on the investment, and sometimes incurring heavy cash loss from operating expenses. One result of such conditions is a reduction of cost to the charterer who might find that it paid him for a short time to abandon the use of the canal, although under normal conditions he used it regularly. The Suez Canal traffic does not fluctuate on this account, because it has practically no free marginal traffic. The term "free marginal" traffic refers to the tramp vessel bound by no obligations but those of economy, and having the possibility of choice of routes other than the canal. The only Suez traffic that is at all marginal is the Australian, and the really marginal Australian traffic goes by the Cape of Good Hope, leaving only the mail lines to pass by Suez. The reason for using the Suez Canal is economy of time, not cheapening of freights, and the mail contracts and the special character and traffic of the vessels render them free from the influence of temporary conditions of the ship market. They must continue their established practice. Much of the Panama Canal traffic, being freight only, could shift to any route that was most profitable, and other routes would rival a high toll Panama Canal.

The American isthmus occupies such a commanding and strategic point in the world system of ocean highways, that the great trunk routes will be examined in succession to

TABLE OF DISTANCES.

	San Francisco.	Yokohama.	Shanghai.	Manila.	Sydney.	Melbourne	Wellington.	Adelaide.	Guayaquil.	Iquique.	Valparaiso.	Coronel.
New York via Present Route	I. II. 13,714	III. 13,564	III. 12,514	III. 11,601	VI. 13,658	VI. 13,083	VIII. 14,333	XI. 12,575	I. 10,425	I. 9,221	I. 8,461	I. 8,130
Panama Canal	5,299	IV. 9,835	V. 10,885	V. 11,585	VII. 9,814	VII. 10,022	8,534	XII. 10,530	2,864	4,021	4,630	4,836
Saving by Canal ..	8,415	3,729	1,629	16	3,844	3,061	5 799	2,045	7,561	5,200	3,831	3,024
New Orleans via Present Route ..	I. II. 14,114	III. 14,929	III. 13,879	III. 12,966	VI. 14,625	VI. 14,051	VIII. 15,301	XI. 13.543	I. 10,823	I. 9,621	I. 8,861	I. 8,530
Panama Canal ..	4,698	IV. 9,234	V. 10,284	V. 10,984	VII. 9,213	VII. 9,421	7,033	9.929	2,263	3,420	4,029	4,237
Saving by Canal.	9,416	5,695	3,595	1,982	5,412	4,630	7,368	3,614	8,560	6,201	4,832	4,023
Liverpool via Present Route	I. II. 14,084	III. 11,640	III. 10,580	III. 9,677	IX. 12,234	IX. 11,659	X. 12,949	11,151	I. 10,722	I. 9,591	I. 8,831	I. 8,230
Panama Canal ..	8,038	IV. 12,574	V. 13,624	V. 14,324	VII. 12,553	VII. 12,761	11,273	13,269	5,603	6,760	7,369	7,577
Saving by Canal ..	6,046	—934	—3,044	—4,647	—319	—1,102	1,676	—2,118	5,119	2,831	1,462	653

I. Via Straits of Magellan.
II. Via Pernambuco and Callao.
III. Via Suez Canal.
IV. Via San Francisco.
V. Via San Francisco and Yokohama.
VI. Via St. Vincent Cape of Good Hope, Adelaide and Melbourne.
VII. Via Wellington.
VIII. Via St. Vincent, Cape of Good Hope and Melbourne.
IX. Suez Canal, Colombo, King George George Sound and Adelaide.
X. Via Suez Canal, Colombo, King George Sound and Melbourne.
XI. Via St, Vincent and Cape of Good Hope.
XII. Via Wellington and Melbourne.

determine the probable changes that will come with the connection of the Atlantic and Pacific Oceans at that point.

The South American trunk route will be the one most affected by the new waterway across the isthmus. It is true that the countries of Atlantic South America will continue to trade as before, but all, or nearly all, of the heavy Pacific trade using this route will be diverted to the canal route. This is especially true of the three regions nearest the canal —the Pacific Coast of United States and Canada, along with Hawaii; western Mexico and Central America; and northern South America. As shown by the accompanying table, the steamer's voyage will then be a little over five thousand miles from New York to San Francisco, as compared with the present journey of over thirteen thousand miles by the Magellan route, a saving of more than eight thousand miles. From Liverpool the saving is two thousand miles less; from New Orleans a thousand miles more. The greater saving from New Orleans is due to the proximity of that city to the canal, and to the westward trend of the Gulf of Mexico, which gives a greater distance from the eastern point of South America. To Guayaquil, the most typical port of the Pacific side of northern South America, the saving in distance from New York, New Orleans and Liverpool is respectively seven thousand five hundred, eight thousand five hundred and five thousand miles. In all cases the routes between Europe or the United States and any of the Pacific-American countries north of Peru will be shortened by a distance one and two-thirds to three times as great as the trans-Atlantic voyage from New York to Liverpool. Every steamer engaged solely in this trade will necessarily use the canal or incur heavy loss by using the longer route.

Toward the southern part of the continent there is some debatable trade, which may follow the Magellan in preference to the Isthmian route. Such trade will, however, be of comparatively small amount and will belong to Europe, not the United States. It will be of small proportions, because the bulk of Chilean commerce originates in the northern part of the country, the part south of 42° S. being practically devoid of population or of trade. More than three-fourths of the entire export trade of Chile is the nitrate of soda and ores of the north; Iquique, the leading port of the district, is near the center of the South American Coast. The agricultural exports come chiefly from Valparaiso, and smaller quantities from other ports as far south as Valdivia. It is the trade of agricultural or southern Chile with Europe that is debatable. For the United States trade with this region the distances saved by the canal practically settle the question of Chilean trade in favor of the canal route. From New York the saving is 5,200 miles to Iquique, 3,800 to Valparaiso and and 3,000 to Coronel; from New Orleans 6,200, 4,800 and 4,000 respectively; from Liverpool 2,800, 1,450 and 650.

The best way to determine the influence of the canal in this trade is to examine the cost of operating ships, and see what tolls could profitably be paid. Fortunately, the practice of chartering steamers permits us to see very accurately what it costs to operate vessels. The owner of the vessel hires and pays the crew and pays for insurance, provisions and engine stores, and in fixing the rate for letting his steamer he is supposed to provide for wear and tear, and for his profits. The charterer provides for agency fees, pilotage, port charges, stevedoring and coal. As the charter money is sometimes agreed to a twelvemonth in advance, and the average coal consumption is known, the cost of a voyage from port to port can be estimated to a nicety.

The actual cost of running steamers is shown by the accompanying record of typical cases. Two British steamers were operated under time charters by an American firm engaged in the Chilean trade. The first column shows the cost to the firm of operating these steamers in the autumn of 1900, a time of great prosperity in the shipping business. The first steamer was much less expensive than the second, because she was nearing the end of a long contract made in a cheaper ship market than then existed. The second column shows the approximate cost of the same steamers if they should have happened to be rechartered at the rates prevailing in March, 1903.[5]

COST OF RUNNING SHIPS.

1. *Gross Register*, 3,048; *Net Register*, 1,954; *Dead Weight Capacity* 5,000, *including Coal and Stores. Freight per dead weight ton per month* (30 *days*.)

	Autumn, 1900.		Spring, 1903.	
Counting 1£, $4.86, 5000 tons	@ 4s. 6d.	$5,467.50	@ 3s. 3d.	$3,947.82
Coal, 20 tons per day, 30 days, 600 tons	@ $3.00	1,800.00		1,800.00
Per month		$7,267.50		$5,747.28
Per day		242.25		191.59

2. *Gross Register*, 3,244; *Net Register*, 2,104; *Dead Weight Capacity*, 5,100, *including Coal and Stores. Freight per dead weight ton per month*, (30 *days*.)

	Autumn, 1900.		Spring, 1903.	
Counting 1 £, $486 5,100 tons	@ 5s. 6d.	$6,816.15	@ 3s. 3d.	$4,027.72
Coal, 20 tons per day, 30 days, 600 tons	@ $3.00	1,800.00		1,800.00
Per month		$8,616.15		$5,827.72
Per day		287.20		194.25

Each of these vessels had a speed of about nine knots per hour, that being the usual speed for the tramp steamers that carry so large a share of the world's commerce. After making allowance for the delay in passing through the Panama Canal, the nine-knot steamer would save twelve and one-half days, avoiding 2,800 miles of sailing. Would it pay the European shipowners in sending their ships to and from the northern ports of Chile to pay canal tolls to save twelve days? For the 1,954-ton steamer, the toll, at $1.00 per ton, would be $1,954, and the saving, at $242.25 per day in 1900,

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[5] At the beginning of January, 1905, the rates would have been from three to six pence less per ton per month.

$2,907; at $191.59 per day in 1903, $2,299.08; for the 2,104-ton steamer the tolls would be $2,104, the saving in the first period would be $3,446.40, in the second period, $2,331. In all cases a considerable cash balance in favor of the canal. Had the voyages been shortened but ten days, there would have been a slight cash loss for both steamers at the period of cheaper rates.

The canal route, however, has advantages not shown in the balance struck between tolls paid and time saved. Insurance rates will be much lower for the safer northern route, and the quicker voyage would usually command a higher freight rate than a longer one, for, in most branches of commerce, time is money. In times of high prosperity the profits of $25, $50, $100 or more per day would very materially affect the use of the canal; every dollar of clear profit per day must be added to the canal credit side of the balance. On the other hand, the loss that the ship charterer may sustain does not enter into the balance, because the balance is based on operating expenses. If these losses bring about reduction in charter rates, they then affect the operating expenses of the charterer and influence his decision concerning use of the canal. The balancing of expenses may in times of exceptional depression occasionally omit the element of freight earnings. If the vessel is not on time charter, but is managed by her owner on the single voyage basis, she might have no freight, and none engaged, and be sent to Chile in ballast or in coal cargo in the hope that return freight could be secured later. Such a voyage would be undertaken as the only alternative to lying idle, and might be succeeded by a period of absolute idleness in a South American port. The owner would calculate the cost of that voyage on the basis of actual cash outlay—coal, crew, stores, insurance, etc., omitting interest and earnings, and would decide about the use of the canal accordingly, and probably to the disadvantage of the total canal traffic. Such voyages would rarely occur.

With regard to the Chilean trade under normal circumstances, it is evident that the 2,800 miles saved from the nitrate ports to Europe, and the 2,900 miles saved from Coronel to New York, are a sufficient guarantee that the trade between the cities named would use the canal if it were now in operation. The trade between Europe, Valparaiso and Coronel has far less promise of aid from the canal. The distance, time and cash savings above cited for the voyage to Iquique must be divided by two for Valparaiso and by four for Coronel. In both cases the balance goes so strongly against the canal route that full-loaded vessels to or from Valparaiso would probably not use the canal, and it appears that a canal toll of $1.00 per ton would be entirely prohibitive for vessels bound to or from Coronel. Even this fact will not prevent some of the trade of the region around Coronel passing through the canal. It is true that a full loaded steamer going to or from Coronel would in all probability follow the Magellan route, but the trade of the agricultural district, in which Coronel is situated, is not usually carried in full cargoes. It consists of miscellaneous imports of manufactures and varied exports of general produce well suited to the lines of steamers that skirt the coast. These lines load and unload at many ports, and of the export cargo from 50 to 80 per cent. is almost invariably composed of nitrate of soda. The nitrate fields are a magnet attracting all vessels that come to Chile, and they would continue to be so if the canal were in operation, with the probable result that the European liners bound for the south of Chile would pass once along the coast, entering or leaving the Pacific by the Panama Canal and the Straits of Magellan. Whether they entered the Pacific by the Canal and sailed south, or whether they followed the reverse order, would depend upon the relative importance of speed in the delivery of Chilean imports or exports. The result upon routes would be the same—approximately one-half of the tonnage passing between southern Chile and Europe using the canal.

The Panama Canal will have very slight influence upon the trade of eastern South America. There is no regular present or prospective trade between the Atlantic and Pacific sides of South and Central America. The basis for trade does not exist because the wants of the people and the natural products are the same. There must be difference in production before there is reason for exchange of goods. The possibility of trade between the Pacific states of the United States and the tropic Atlantic countries is largely cut off by the proximity of Chile and the Argentine Republic, both capable of supplying grain, fruit and other temperate zone produce. The only economic want of the Atlantic side of South America that is being supplied, or is likely to be supplied from the Pacific is the demand for soft wood lumber from California and Washington. This commodity is shipped in full cargoes to the River Plate ports and Brazil, and there is likely to be a steady demand for it on the entire east coast. Owing to the eastward projection of the coast of Brazil, there is no economy in using the canal in a voyage from San Francisco or Puget Sound to any port of the east coast below Rio Janeiro. In reaching the Brazilian and other ports to the northward, the canal will be used, but the trade is likely to be only an occasional one.

All tropic America imports temperate zone flour or wheat, or both, and the opening of the Panama Canal may give to the Pacific wheat growers a monopoly of the Caribbean flour markets. The world's wheat price is fixed by the European demand, and the price in any port is likely to be the Liverpool or London price minus the freight rate to those ports. Wheat is higher in New York than in Buenos Ayres, and higher there than in Valparaiso, while the Valparaiso price is higher than that of San Francisco or Portland. The wheat price declines as the stations on the South American trunk route are more widely separated from the central price-setting market. Accordingly, when the South American crops have failed, it was not New York, but California that supplied Brazil with wheat, because the Californian must usually pass directly by the Brazilian ports en route to market in Europe. For the same reasons California flour is now shipped across the Isthmus of Panama by rail and reshipped to Port Limon on the Caribbean for distribution in Costa Rica. Flour is as cheap, or is cheaper, at Panama than at New Orleans or New York. The opening of the canal will increase the advantages of California and Chile as wheat and flour purveyors to all the Caribbean ports. The canal is the gateway through which these grain producing countries will reach the great world market on the Atlantic, and the Caribbean and West Indian ports are directly upon the route.

The opening of the isthmian canal will work changes in the Mediterranean-Asiatic trunk route, second only in extent to those to be experienced by the South American trunk. The traffic lost to the Suez Canal and to the Mediterranean-Asiatic route will be gained by the Panama Canal and the American-Oriental route. To one accustomed to the Mercator's projection maps it may appear strange that the route from the American isthmus to Asia should be the Pacific Coast-Oriental, the same as that from the Pacific Coast of the United States, but, practically, such is the case. This route will be merely extended to the isthmus. The direct or great circle route to Shanghai follows the coast of Mexico as far as southern California, and then crosses to Japan close to the track followed by San Francisco steamers. This route is fourteen hundred miles shorter than the southern route to Shanghai, via Guam and Manila, and has the advantage of passing near the ports of Japan and the United States with their harbors and freight and coal. The shortest route passes directly by Yokohama and so close to San Francisco that a call can be made at that port by an additional one hundred and fourteen miles, but it requires a deviation of three hundred and sixty-six miles to make a stop at Hawaii. It is, therefore, safe to say that San Francisco will be an important port of call on this route, and that the shipping diverted by the Panama Canal from the Mediterranean-Asiatic route will be transferred to the Pacific Coast-Oriental.

In considering the effect of an isthmian canal upon the South American route, the improved waterway was in competition with the free and open sea route, and the question was one of determining the balance between tolls and distance. The question is a different one with the Mediterranean-Asiatic route, because it involves balancing the advantages of two canals which will probably have different rates of toll.

The consideration of the probable effects of the Panama Canal upon the trade routes of Asia involves, as it did in the case of South America, the pointing out of geographic limits of the canal's influence upon the trade of the United States and of northwestern Europe.

With the trade from the American side of the Atlantic it is evident from the distances saved that the trade of Japan and North China belongs exclusively to the American route, and that of Burmah, India and other points west of Singapore belongs as exclusively to the Suez Canal. Somewhere between these regions is the trade divide.

The distance divide is very close to Manila, the distances being as follows: New York to Manila, via Panama, San Francisco and Yokohama, 11,585 miles; via Suez, Colombo and Singapore, 11,601 miles; via Panama, Honolulu and Guam, 11,642 miles. It is evident that, other things being equal, the navigator would have small choice between the Suez and Panama routes to Manila. But other things are not equal, and it is upon the comparative merits of the other elements that the choice of the route depends.

The first and greatest element of difference will probably be the rate of toll at the two canals. The Suez rate is 8.50 francs per ton, Danube measurement, which amounts to approximately $2.00 per ton net register, English or American measurement. This rate is not likely to be reduced, nor is the American canal charge likely to exceed $1.00 per ton. This difference of $1.00 per ton was found in the case of South American trade to be the equivalent of 2,000 miles or more of steaming.

The American route has a further advantage in the greater amount of freight that may be delivered or collected en route. By comparatively short extensions of the journey, such as line steamers continually find it profitable to make, stops can be made at Hong Kong, Shanghai and Honolulu, while San Francisco and Yokohama are bound to be upon the route if present practice be any guide to predictions of future action. It is possible that a Mexican port may be added to this list, as Acapulco lies directly on the route, and Mazatlan is but a short distance to one side. This succession of ports on the Pacific Coast-Oriental route offers greater commercial advantages than are to be found in going by Suez, where Singapore is the only freight port of the first rank, Colombo being decidedly in the second rank and Aden, beside the deserts, is of still less importance.

The route by the American isthmus will probably have the more favorable coal supply. In crossing the North Pacific there is a long gap between coaling stations, but, on the whole, coal is likely to be cheaper upon the American route. The first station of importance promises to be at the canal, within the reach of barges from New Orleans or Mobile. This cheap form of transportation for coal which is cheaper to start with than the European, will give cheaper coal at the Panama Canal than in the Mediterranean. The Isthmus of Panama is on the route to western South America, the only part of the world from which we import a greater bulk of merchandise than we export. Hence, American coal with the possibility of going out as ballast cargo will be cheap on the isthmus. The increasing coal output of Washington State and British Columbia, furnishes another supply near the route to Asia. At Yokohama Japaneses coal is to be had cheaper than the same coal at Singapore, where it is the main dependence of the steamers via Suez. The coal supply of the new route is likely to be further improved by the opening up of the almost limitless coal fields of China.

The greater safety of the Pacific route will secure for steamers following it a somewhat more favorable insurance rate. The typhoons of the Chinese Seas, the narrow and rocky passages of the Red Sea and the storms of the Atlantic are dangers which the insurance companies can and do estimate in cash, and which the steamers coming to and from New York by the Panama route will largely avoid.

Of the two canal routes from New York to the Orient, that by Panama promises to have the four advantages of cheaper tolls, more way freight, cheaper coal and less insurance. The combined effect will be the removal of the trade divide between the two routes a considerable distance to the westward of the distance divide. It cannot be stated with accuracy how far beyond Manila it will be, but under present conditions for full loaded vessels, it would, in all probability, be between one thousand and two thousand miles. The Panama Canal would certainly have all the Atlantic-American trade with Japan, China, the Philippines and French Indo-China, and probably a large part of that from Singapore, which lies well within the 2,000-mile limit. It is probable that Singapore would become a terminal point for lines coming from both directions, or again it is possible that vessels might come by one route and return by the other. These occurrences are the more likely because of the prominence of steamer lines rather than chartered vessels in the trade of the Orient. The line steamer, in order to balance a voyage and complete a freight service, or keep out competitors, may extend its itinerary to points that a chartered steamer, coming from the same port, would reach by a different route. For example, there are lines of steamers passing from Europe down the east coast of Africa from Aden, and others going up the coast from Cape Town. The services of these lines overlap by about 1,800 miles. Other lines entirely circumnavigate the African continent, and some vessels go one way and some the other. In the same way the completion of the Panama Canal will open a round-the-world route, whereby steamers from New York may skirt the coasts of Asia in both directions, and lines may overlap along southeastern Asia, giving Singapore and ports to the east a double service to the Atlantic ports of the United States.

For the commerce between Europe and eastern Asia the Panama Canal offers no advantage of distance. The American route has a handicap of nearly a thousand miles from Liverpool to Yokohama and three thousand to Shanghai. From the Mediterranean ports of southern Europe these distances should be increased by three or four thousand miles. Will the commerce of northwestern Europe with eastern Asia be able to utilize the Panama Canal? Under the toll conditions outlined above, it probably will to some extent. The ordinary tramp steamer, passing between Liverpool and Yokohama, could profitably expend four to six days in going the extra nine hundred and thirty-six miles of the American route if she saved her owners thereby one-half of the present Suez Canal tolls. Line steamers would also be very likely to use the same route on the return voyage to Europe. It is the custom for liners going out from Europe to China to end the voyage at Yokohama. But once in Yokohama, the most economical route for the return is by way of America. The steamers could discharge and receive cargo at Hong Kong and Shanghai, and continue from Yokohama to San Francisco. The freight conditions in this part of the world would favor this practice because the trade from China and Japan toward Europe is much lighter than that going the other way. The steamers at Yokohama are, therefore, in straits for freight, and it would be natural for them to seek the abundant freights of California, and thus adopt the practice that is being, and has long been, followed by many sailing vessels that have discharged cargoes in the ports of East Asia. This prediction is further strengthened by the recent establishment of a line of steamers running from England to China and Japan, and then for the sake of a return cargo going on to Portland, Ore., securing nearly a full cargo of wheat, returning thence to Asia, where such other cargo as may be secured is added, and the whole carried westward through the Suez Canal to

Europe. With the Panama Canal in operation it is scarcely possible that these steamers would return to England by the longer Asiatic route. If the Suez Canal tolls should be as low as those at Panama (which is very unlikely) the use of the American route by regular lines from Japan to Europe, would be probable, because the temptation of Pacific Coast freight would continue strong and would certainly, as at present, draw many tramp vessels across the North Pacific.

A natural factor of some importance in the consideration of this round-the-world route is the prevailing westerly winds, which, even to steamers, are an aid in going from west to east, and a drawback in going from east to west. The steamer going from Europe to Japan by Suez and returning by Panama, would be aided over a large part of the distance by the prevailing world winds.

The routes of Australasian trade will be materially changed by the opening of the Panama Canal. There will be a new steamer route worthy to be classed with the world's trunk routes: the Australasian trunk, connecting Australia, New Zealand and the Isthmus of Panama. This new route will draw commerce from four of the existing trunk routes, but none of these will be entirely replaced. The heaviest loser will be the South African trunk route; the Mediterranean-Asiatic route may lose some of the traffic now passing to Australia via the Red Sea; other contributors to the new route will be the American Pacific Coast-Australasian and possibly the New Zealand-Cape Horn branch of the South American trunk route.

Australasian trade is predominantly with Europe, but the trade between the eastern United States and Australasia should, in this connection, be considered first, because of the greater saving of distance to be affected by the Panama Canal. At present, this carrying trade appears to be in a stage of gradual transition from sailing vessels to steamers. All vessels of both types to both Australia and New Zealand go out by the South African route via Good Hope. With the Panama Canal in operation, two routes are offered across the Pacific: one from Panama to Sydney, via Tahiti and Society Islands; the other via Wellington, on the straits separating the Isles of New Zealand. The first route is divided into nearly equal parts by the call at Tahiti. This is an advantage in coaling, but coal is bound to be high at such a place, and the route is four hundred and five miles longer than the one by Wellington, which will have cheaper coal and a safer route for navigation. Judged by these general considerations, and by the coaling practice of the steamers on the Good Hope route, it is improbable that the Tahiti route will be used by Australasian steamers going to and from the canal. This discussion is, therefore, based on the supposition that all Australasian steamers follow the direct route from Panama to Wellington.[6] The saving of distance to a steamer using the Panama Canal rather than the present Good Hope route, will be from New York to Wellington, 5,800 miles; to Sydney, 3,800 miles; and to Melbourne and Adelaide, via Wellington, 3,000 and 2,000 miles respectively; from New Orleans the saving is about 1,500 miles greater. These reductions of distance are in competition with a safe, free and open sea route. Will the canal be used?

The answer to this question cannot be wholly reached by an analysis of the distances to single ports. That method is only measurably correct for the tramp vessel in- or outbound with full cargo, because the coal supply of Sydney causes that port to be visited by almost every steamer that goes to Australia. But the trade of Australia is not very largely a tramp vessel trade, nor does it promise to become so. It is chiefly a line traffic, and is becoming more so with the increase in the use of steamers. Excepting one or two small lines, the vessels to southeastern Australia all go to the three ports of Adelaide, Melbourne and Sydney. The effect of the canal upon these liners is to be understood by considering the three ports, not as isolated units, but as links in a chain and we must consider the chain in its entirety. The steamer visits all of the ports, and, as she begins at one or the other of the ends of the chain, we must measure distance from the end ports in the chain. By way of Panama, Sydney, the easternmost of the three leading ports is 3,761 miles nearer New York than Adelaide, the westernmost port, is via the Cape of Good Hope. This distance advantage is somewhat magnified by the greater importance of Sydney and its trade, and the desirability of reaching it with cargo as soon as possible. When the voyage is completed at Adelaide, the steamer can return to New York via Melbourne and Wellington with a saving of over 2,000 miles from Adelaide. This saving of 2,000 miles from Adelaide is somewhat under the margin of cash saving necessary for canal use as shown in the analysis of South American trade, but the return ports offer good freight and the coal supply at Sydney is an attraction that draws nearly all steamers visiting Australia. There will be another advantage in the probable cheapness of coal at the Panama coaling station. The winds and currents of the Good Hope route are very unfavorable to returning vessels, and the high value of Australian import and export cargo gives a high value to the time element. Summing up the situation it seems reasonably certain that the trade of the eastern United States with Adelaide and Australasian points lying to the eastward, would go and come by the New Australasian trunk route and the Panama Canal if that waterway were now in operation. If present conditions continue it would be a common occurrence for vessels to return to the Eastern States via the Suez canal with East Indian cargoes, because Australia imports greater bulk of American goods than she pays for in kind, and vessels seek cargo in other countries.

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[6] A direct voyage from Panama to Sydney is of about the same length whether going to the north of New Zealand or through the straits between the main islands

The canal will not offer such advantages for the Australasian trade with Europe. At present the greater part of it uses the South African trunk route, and from New Zealand the return trip is commonly made by the Straits of Magellan, thus completing a round-the-world voyage. The Suez route gives a saving of less than 1,000 miles from European ports, and it is used only by lines carrying mail or passengers. The Panama route from Liverpool to Wellington is 1,676 miles shorter than the Suez route, and 641 miles shorter than the Magellan route, but to Australian ports it is longer than the Suez; by 2,118 miles to Adelaide, 1,102 miles to Melbourne and 319 miles to Sydney. It is evident that there is no reason for European line steamers going out to Australia by the Panama route. The situation assumes a different aspect when Sydney has been reached and the return is in order. It is desired that the ship with her valuable cargo, passengers and mail reach Britain as quickly as possible. In comparison with Suez, the Panama route has the handicap of 300 miles, less than 3 per cent. of the total distance; it has the advantage of offering more passengers and mail at Wellington, good coal there and at Panama, favorable winds in the South Pacific and North Atlantic and probably a gain of $1.00 per ton register in canal tolls—advantages enough to enable the shipowner to use the route with no loss of time and some gain in money.

During the year 1903 the average voyage for the eight White Star liners plying between New York and Liverpool averaged 5.14 per cent. longer in time going west than east. Expert navigators say that there are so many elements of difference between the east and west voyages that this percentage cannot be cited as a measure of the influence of wind and currents. It is, however, suggestive of some such influence.

The present fast mail route from Sydney to Great Britain is not via Suez, but by fast steamers to San Francisco and Vancouver, express trains to New York and from New York to Queenstown by the trans-Atlantic liners. The competition between this route and the Panama route raises an interesting speculation. The route via San Francisco is longer, but has the advantage of the American train service and the fastest steamers in the world. The Panama route is nearly 2,000 miles shorter, but cannot afford the fastest of steamers.

The mails from Melbourne, Adelaide and West Australia could not go by the Panama route without considerable loss of time, so the possible adoption of a Sydney mail via Wellington and Panama would not prevent the Melbourne and West Australian mail following the Suez route as at present.

There is no likelihood of the canal route (with tolls at $1.00 per ton) diverting to itself any of the Australian-European freight that goes by Good Hope, for at best the saving is considerably less than 1,000 miles. There is less possibility of atracting the New Zealand freighters that go by Magellan.

The Pacific Coast-Australasian trunk will have its traffic diminished by the diversion to the new Australasian trunk of practically all of the freight that originates *in the Mississippi Valley,* and is exported through San Francisco. Under the new conditions some Atlantic or Gulf port will surely have this traffic, which is even now of inconsiderable dimensions owing to the competition of the New York steamers.

THE EFFECT OF THE PANAMA CANAL UPON THE MARINE COAL SUPPLY.

The new canal will bring about some changes in the coal supply and the relative importance of coaling stations, but its effects will be much less pronounced in this field than in the routes of trade.

The chief change in the coal supply will be in the enlargement of the field for American coal. The Pacific will be tapped, and as our eastern states now supply the Caribbean, so they will then supply northern South America, western Mexico and possibly California to some extent. The latter region has many champions who maintain that the Puget Sound district has coal that will satisfy in both quantity and quality the demands of the Pacific coast of the United States. An Atlantic coal supply for the Pacific ports within 2,000 miles of Panama is made the more probable by our relatively heavy imports from that region, and by the feasibility of shipping coal in barges as it is now shipped along the Atlantic Coast from the Delaware and Chesapeake to New England.

Individual coaling stations will, in the main, be affected by the canal only as the different routes are increased or decreased in importance. There will be a few exceptions to this. One of the greatest coaling stations in the world will arise at Colon or Panama, the termini of the canal. It is also possible that a station will be established somewhere on the western coast of Mexico to break the journey to San Francisco. Acapulco and Magdalena Bay are suitable harbors. The latter is a magnificent, but almost unused harbor on the coast of lower California. The freedom of this shore from fogs and storms makes easier the use of coaling stations along the coast. Both of these harbors are immediately upon the route of steamers bound from the canal to San Francisco or the Orient, and the nearness to the mineral and agricultural regions of western Mexico gives promise of return freight for vessels carrying out coal. The canal will probably cause the establishment of a coaling station of secondary importance at Tahiti. As pointed out above, it is not likely to be regularly used by the Australasian steamers, but it will be by some engaged in the Polynesian trade, and by Australasian steamers in cases of emergency.

THE CANAL AND THE WORLD'S SAILING ROUTES.

The Panama Canal will divert steamer traffic from one steamer route to another, and will create new routes for some of the diverted traffic. The existing sailing routes will also lose a share of their traffic, but it will probably be transferred to steamers and steamer routes, rather than to new sailing routes, passing through the canal. Two main reasons lead to this conclusion. The first is the general decline of sailing vessels in the world's trade, combined with the superiority of steamers in short rather than long routes. The canal will substitute short for long routes. For a comparison of the two types of vessels see the chapter on that subject. The second reason is the peculiar disadvantage of the Pacific Ocean near Panama for sailing vessels.

It should be remembered in this connection that the Suez Canal is not used at all by sailing vessels. The narrow, rocky and calm seas of the Suez route are not duplicated about the Panama route, but the handicaps to sailing vessels are great enough to render unlikely their successful competition with steamers passing through the canal. The Pacific Ocean south and west of the isthmus is a calm sea, and the sailer must have wind. The equatorial zone of calms reaches nearly to Panama, and the trade winds which should blow from the northeast are cut off by the isthmus; but the land is not wide enough to set up an extended land and sea breeze or monsoon wind action. Consequently a large area of the Pacific, including the Bay of Panama is so ill supplied with winds as to be a great drawback to the use of the canal route by sailing vessels (see Chapter IV). They can, with proper towing through the canal, make successful use of the waterway, but will it be profitable and become a factor in international trade? It may to a limited extent, and for a limited time after the canal is opened, but it is the prevailing opinion of hydrographers, sailing masters and ship brokers that the Panama Canal will not be practicable for the use of sailing vessels. In the opinion of the Isthmian Canal Commission also, sailing vessels will play a very limited rôle in the canal traffic. Sailing routes will remain practically as they are, and will have a decreased traffic as a result of the advantage that steamers will derive from the new waterway.

CHAPTER IX.

THE COMPETITION OF THE STEAMER WITH THE SAILING VESSEL IN THE WORLD'S CARRYING TRADE.

In the shipping world a revolution in motive power is in progress and nearing its close. After an undisturbed supremacy of more than a thousand years the sailing vessel is being displaced upon all oceans by the steamer. It is a competition between low costs and low efficiency, and high costs and high efficiency, and high efficiency is winning.

The sailing vessel has free power, cheap construction, a minimum of motor machinery, a maximum of storage space and a small crew. But the free power is uncertain, slow and sometimes fails entirely.

The steamer is more expensive to build and her machinery and coal bunkers occupy about one-third of her capacity in comparison to the 5 per cent. lost space in the sailing vessel. Her repairs and coal are expensive, the crew three-eighths larger in proportion than in the sailer, but she is faster and much more dependable and efficient. "The ratio of four to one being the present measure of the efficiency of steam tonnage compared with sail tonnage."[7]

That both types of vessel have been improved is shown by the declining number of men in their crews. For British vessels engaged in the foreign trade the number of crew per 100 tons net register has been as follows:

	1880.	1890.	1898.	1901.
Sailing Vessel........	2.32	1.96	1.65	1.61
Steamer	2.95	2.73	2.32	2.22

The steamer, depending so much upon machinery, has a greater field for improvement. A steamer built in the middle of the nineteenth century and broken up in 1899 was found to have engines that weighed seventeen times as much per horse-power as the best type then being put into new vessels. This mechanical perfection is illustrated in the new American steamers that have been built to replace the sailing vessel line from New York to San Francisco. Some of these vessels can carry 10,000 tons dead weight of freight and 2,500 tons of coal. If the Panama Canal were open it is expected that they would make the 5,000-mile voyage from New York to San Francisco at nine knots per hour with 1,000 tons of coal, or one ton of coal for ten tons of freight. With coal at $3.00 per ton, the coal cost of a ton of freight carried 5,000 miles would be 30 cents. Small wonder that the manager of these steamers exclaimed, when comparing them to sailers, "Oh, the coal is a bagatelle."

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[7] Rep. U. S. Com. of Navigation, 1903, p. 181.

The progress and the effect of these improvements is reflected in the statistics of tonnage in the world's mercantile marine. Table 1 shows that during a twenty-five year period, from 1874 to 1899, the steam tonnage of all countries increased enormously, the average for the world being 336 per cent., more than 100 per cent. per decade. During the same period (see Table 2) when steam had increased so rapidly the sail tonnage declined relatively and absolutely. The percentage of decline was 40 in the twenty-five years, and Norway was the only country that held its own. In the five years since the close of that period Norway's sail tonnage has declined one-third.

Table No. 3 shows that the greater part of the decline in sailing vessels has occurred since 1890. At that date sailers outranked steamers by nearly a million tons. In 1903 the proportions were nearly 3 to 1, 16.8 millions to 6.4 million tons, or, of the total merchant shipping afloat but 27.7 per cent. was propelled by sail. From the standpoint of work done, it appears, by using the above given rule of efficiency, four tons of sail equal one of steam, that sailing vessels are now doing but 8.8 per cent. of the world's ocean carrying.

TABLE I.—SEAGOING STEAM TONNAGE OF THE WORLD.

COUNTRIES.	1873–74.		1878–79.		1888–89.		1898–99.		Increase 1873–74 to 1898–99 Per Cent.
	Tonnage.	Per Cent.	Tonnage.	Per Cent.	Tonnage.	Per Cent.	Tonnage.	Per Cent.	
Great Britain	2,624,431	60.4	3,465,187	62.4	6,873,552	62.3	10,993,111	58.5	311%
United States	483,040	11.2	609,101	10.8	535,345	4.8	810,800	4.2	68
France	316,765	7.4	335,219	5.9	752,028	6.8	952,682	5.1	200
Germany	204,894	4.8	253,667	4.5	662,331	5.9	1,625,521	8.3	693
Spain	138,675	3.3	152,708	2.7	395,685	3.5	520,847	2.7	275
Italy	85,045	1.9	84,421	1.5	276,326	2.5	420,880	2.2	395
Holland	72,753	1.7	116,149	2.	197,748	1.8	363,200	1.9	399
Russia	67,522	1.6	104,702	1.8	163,556	1.5	358,415	1.8	430
Norway	41,602	0.9	53,331	0.9	160,558	1.4	628,493	3.3	1,410
Japan	—	—	—	—	115,088	1.0	439 509	2.3	—
All Others	293,466	6.8	420,690	7.5	913,720	8.3	1,773,674	9.5	504
	4,328,193	100.0	5,595,175	100.0	11,045,937	100.0	18,887,132	100.0	336

TABLE 2.—SEAGOING SAIL TONNAGE OF THE WORLD.

COUNTRIES.	1873–74.	1878–79.	1888–89.	1898–99.	Percentage of Decrease from 1874 to 1899.
Great Britain	5,320,089	5,596,018	4,215,634	2,910.555	45
United States	2,132,838	2,075,832	1,913,090	1,285,859	40
Norway	1,137,177	1,374,824	1,328,296	1,144,482	.6
Italy	1,126,032	963,625	718,889	463,767	59
Germany	893,952	914,674	737,028	535,937	40
France	768,059	595,933	352,418	279.412	64
All Others	2,807,689	2,796,524	2,370,934	2,073,757	26
Total	14,185,836	14,317,430	11,636,289	8,693,769	40

TABLE 3.—THE WORLD'S MERCHANT MARINE.

[Recorded in Lloyds, 100 tons or over]

YEAR.	STEAM.		SAIL.	
	Number.	Net Tons.	Number.	Net Tons.
1890	11,108	8,295,514	21,190	9,166,279
1893	12,588	9,622,610	19,452	8,983,957
1894	12,907	10,111,769	17,814	8,503,294
1895	13,256	10,573,642	17,112	8,219,661
1896	13,652	11,027,603	16,228	7,876,264
1897	14,183	11,531,829	14,168	7,300,839
1898	14,701	12,073,074	13,351	7,049,958
1899	15,324	12,935,994	12,856	6,795,782
1900	15,898	13,856,513	12,524	6,674,370
1901	16,528	14,874,253	12,563	6,591,627
1902	17,156	16,026,372	12,472	6,577,776
1903	17,761	16,822,466	12,182	6,459,766

This decline has been general, not local; it has affected the shipping of all countries, the trade of all oceans and of almost all commodities.

The claim is often made that there are special commodities and particular routes that belong exclusively to the traffic of the sailing vessel. Conspicuous among commodities supposed to belong to the sailer are nitrate of soda from Chile, lumber in the American coasting trade and elsewhere, and wheat from San Francisco. Within the past decade the shipment of full cargoes of nitrate by steam has become common, and several lines of steamers regularly carry it as a large part of their return cargo. Special steamers have been built to carry Carolina pine to New York and New England, and in 1901, 1902 and 1903 steamers carried many cargoes of Pacific Coast grain to Europe. It was, it is true, done at a loss, but such periods come rather frequently in the shipping industry. It is not being claimed here that the steamer promises immediately to replace the sailer in this trade, but it has already competed for full cargoes. Much more significant is the consolidation of all sailing lines between the two coasts of America, and the sale of these vessels and their replacement by high type steamers. Upon the opening of the Panama Canal the sailer will probably be entirely displaced in the Atlantic-Pacific trade by the apparently impossible task of competing around Cape Horn with a steamer passing through the canal, and saving more than half of the distance.

The route from New York to Australia was claimed by Lieutenant Maury, the great ocean expert of forty years ago, as the perpetual home and exclusive possession of the sailer. The route is long, the winds are fair and coaling stations for the rival steamers are scarce and expensive. In the year 1896 several lines added steamers to their service, and have maintained them for eight years and are shipping a large, if not the greater, part of the freight by them.

It appears from the statistics that there has been a pause in the downward course of sail tonnage. During the five years, 1899 to 1903, the total decline was not much greater than the annual decline from 1890 to 1899. This halt was due largely to the great boom of 1898 and 1899, which made every kind of vessel profitable in the extreme, and produced the greatest increase of steam shipping ever known. Interest has also been attracted by a new type of sailer, the six and seven-masted schooner, with steam sail hoisters and very small crew requirements. This improvement, however, should be set off against the oil-burning steamer, which is a corresponding improvement in the rival type, eliminating much labor, and which is being used much more extensively than the giant schooners.

The extinction of the commercial sailer is not predicted here. For a long period to come there will be some distinctly sailing vessel work, but further decline of tonnage seems evident. She cannot hold her paltry twelfth part. In 1902 the British steam tonnage increased 708,000 tons and the sail tonnage declined 65,000 tons. The traffic upon which the sailing vessel has the strongest hold is some irregular and spasmodic trade, both coasting and foreign, which cannot be organized and handled as line traffic. The beginning of a new trade may be the occasional departure of a sailing vessel. Such a trade is now arising between the Gulf ports of the United States and the La Plata ports. If it grows, a line of steamers will take it over and most of the sailers will be displaced, giving another reduction to sailing tonnage.

There are times when the sailing vessel is desired because the low speed and consequent long voyage enable the shipper to save storage expenses at one of the termini, but the competition of a seaworthy ship as a mere storage warehouse is not a strong foundation for continued prosperity.

CHAPTER X.

GOVERNMENT CONTROL OF SHIPPING.

In the chapter on ocean freight rates much emphasis was laid upon the freedom of the ship to go wherever her navigator wished, and the great and unrestrained freedom in making rates. From port to port the ship is practically free, but within the limits of a port all is changed. Few, if any, forms of commercial activity are so extensively regulated by law as the building, maintenance, loading, departure and arrival of shipping. This great care is needed because of the great risks to life and property, and the numerous interests at stake. Opposed to these is often the immediate pecuniary interest of the owner, who, safe on land, might be willing to jeopardize the lives and properties of others in a ship inadequately built, out of repair and undermanned; accordingly the lives of the passengers and crew are safeguarded by law as is the property of the freight shipper and the public health, which, by the movement of ships is constantly exposed to the dangers of imported diseases. Public revenue being in part derived from tariffs furnishes another motive for the control of the movements of shipping.

Shipping regulations fall naturally into three groups: (a) building regulations; (b) loading regulations; (c) regulations of departure and arrival.

(a) The building regulations are about as thorough as human ingenuity can make them to prevent dangers to life and property that may result from the desire for economy on the part of the carrier. The United States and foreign statutes cover a vast amount of technical detail, and in this country the enforcement of the law and the making of further necessary regulations are lodged in the hands of the Secretary of Commerce, who works through a board of expert inspectors. A few examples will serve to show the nature of this supervision. The rivet holes in a marine engine boiler must be drilled, not punched, because drilled plates are stronger. Every piece of metal subject to a tensile strain must be inspected, and every boiler plate must be numbered and stamped by its maker, showing his name and the strength of the piece. Further, the inpectors must keep in their books the record of every one of these boiler plates that is used. Passenger steamers must be divided, according to their size, into a prescribed number of water-tight compartments, the legal prescription for the partitions being very minute. The passenger steamer has elaborate and detailed provisions for defence from fire, and for life boats, life preservers and other provision for accidents, and the construction must provide for easy exit for passengers. Air space per capita, light, ventilation and drainage are prescribed for both passengers and crew. Other living freight, live animals, are as carefully legislated for as human beings, in some respects they are more carefully safeguarded. The maintenance of this efficiency is provided for by annual inspections of both machinery (if a steamer) and hull, and along with the power of inspection goes the power of condemnation and prohibition to go to sea. If the hull of a vessel is wood, the inspector may assure himself of the condition of the timbers by boring into them until he is satisfied. All important countries have somewhat similar marine codes.

In the matter of shipping, governments, the protectors of peoples, make every effort to see to it that when a ship is permitted to receive cargo, she promises to be able to carry it in safety. The above mentioned provisions of construction and inspection are but types, and no pretense is made of covering the whole of these subjects.

(b) Loading regulations. A ship at her pier might be loaded with cargo until her decks sank almost to the water's edge and there would be no risk while at the pier, and she might even cross the ocean in safety. So long as the depth of loading was to be decided by personal opinion there was always the temptation to overload and take risks to gain profits, particularly as the men who load ships rarely ride in them. Sometimes this danger took a more virulent form and a poor ship was loaded, and overloaded, with a trifling cargo and falsely insured, and sent to sea with the hope that she might sink and thereby bring profit to the enterprise through the insurance. The "coffin ships," as they were called, were long a subject of work for the philanthropic legislator, and all countries have now limited the depth to which each ship may be loaded and it is distinctly marked upon her sides. The British mark, a white circle with three lines across it placed amidships, is called the Plimsoll line, and makes different provisions for different seasons and oceans, according to the risk involved. No ship is permitted to clear from port with her load limit line below water.

The marine codes of nations provide that dangerous articles such as unslaked lime, explosives and dangerous combustibles must be shipped under their own names always, and in some cases they may not be taken on passenger ships. Freight must also not be placed dangerously near the engines, nor must it impede their operation nor the free passage of passengers.

(c) Regulations of departure and arrival. After a ship is built according to law, much care is required to maintain her identity and preserve her operation in accord with safety and with the tariff and health laws of the various countries. If a ship bears no marks of identity upon her, she has increased opportunity of unfair dealings, and preservation of identity is, therefore, a strong means of control. This is exercised by the arrangement known as registry, which corresponds closely to the system of giving deeds to real estate. The piece of land for which there is no deed belongs to the state, and the ship without a register is an outlaw subject to heavy fines. Ships are usually registered in the port where the owner, owners or a majority of them live. The power of issuing registers in the United States lies with the collector of the port. A prescribed blank is filled out, containing the name, a full description of the ship, names of owners, and a large number of measurements made by the surveyor of the port. This document, after being approved and recorded by the collector of the port, goes with the ship like the deed does with a house, and must be shown on many occasions. Even the name of the vessel must be approved, a change of name must be approved and change of ownership requires a new register. The ship's name and home port must be painted upon her stern in readable letters.

In the securing of a crew the ship must have the legally prescribed number, and often qualifications of citizenship and technical fitness must be observed. Pressed by the necessity of having a sufficient crew, captains have for ages put to sea with unwilling men secured ("crimped") by force, fraud or under the influence of liquor or drugs. In combination with the practice of advancing pay, "crimping" has enabled sailors' boarding house keepers to make a bargain and ship a boarder, and get pay and over-pay for his indebtedness. To prevent this abuse laws now provide that, in the United States, the only third party who can make a bargain for a sailor, for an American ship, is a government official called the shipping commissioner, or in his absence the collector of the port. These contracts with the sailor must tell where the voyage is to end, the service the man must give and the wages and supplies he is to receive, and there is a penalty for shipping a man without agreement. There must also be proper provisions, medicines and stores for this crew.

When the ship is loaded, and fully manned, she cannot depart without clearance papers, which the captain receives from the collector of the port after he has presented a copy of the manifest of the cargo, giving the articles and value, and if it consists of packages, the number of, and marks on, the same. From these documents come statistics of export trade.

In addition to these regulations, the ship is often compelled to take a pilot to get from the port to the open sea for the real beginning of the voyage.

In entering a port of the United States, and most other countries, the above list of requirements is reversed and lengthened by the addition of quarantine regulations. The quarantine station is usually between the harbor and the sea. Here the ship must stop, present to the health officer a bill of health received from the health officer of the port of departure, showing the sanitary history of the vessel, and stating that she sailed without cases of contagious or infectious disease on board. The ship is then inspected to ascertain her present condition, and if need be she is disinfected or detained at quarantine, freight, passengers and all. If serious epidemic is threatened, and the conditions seem to warrant it the President may suspend commerce entirely in the interests of public health. If the quarantine officials are satisfied with the condition of the ship, they give a bill of health. With this paper and the bill of health from port of clearance, the vessel is prepared to enter the country, and can do so by presenting both documents to the harbor master, who admits the ship to port and assigns her moorings or anchorage.

Before the cargo can be broken, the captain must present his clearance papers and register to the collector of the port, who holds them, or a consul's receipt for them, until the ship is ready to depart. Thus, the collector, the representative of the custom's authority, keeps the ship under his control during the whole of the time that cargo is being discharged and loaded, and the vessel is, when in touch with the land, always responsible to some controlling authority. Freedom begins when the pilot leaves the ship at the edge of the open sea.

CHAPTER XI.

GOVERNMENT SUPERVISION OF OCEAN ROUTES.

The ship properly built, loaded, equipped and ready for the sea would still be a helpless prey to many destroying agencies but for the aiding and protecting arm of governments. The condition of the ungoverned middle ages would return, and commerce would resume the risks now experienced in polar exploration or by land explorers in savage regions. The unaided ship would be beset by the dangers of grounding on unknown bars, being wrecked on the rocks and shores of any coast, of being tempted there, as of old, by the false lights and bells of wreckers, and the pirate would find the present day commerce of unprecedented richness. But all these dangers the state has taken the pains to reduce or to remove by activities that extend around the world. Chief among these activities are the coast survey, the lighthouse system, storm warnings, ocean pilot charts, the life saving service and the protection of navies.

The approach to a coast is always a dangerous time for shipping. While far at sea, and favored by good weather, the mariner can locate himself by astronomical observations, but when nearing the land the slightest error is dangerous, every possible means must be availed of, and all leading nations have aided navigation by surveying and charting their coasts. These surveys are of the greatest accuracy, and the resulting charts give a minute delineation of the coast line and sometimes a sketch of the topography of adjacent lands; the form of the bottom of the adjacent waters is shown, as are the depth of the water and the character of the bottom as far out as ordinary soundings can bring up a sample; the positions of bars, harbors, channels, and the lights and buoys that mark them; the velocity and direction of currents, the temperature of water, variations of the magnetic needle, and any and all other information that will aid in the navigation of ships. Some shores, with shifting sands, require almost constant surveying and re-charting. The coasts of United States and Europe have been charted and the charts are usually sold to mariners at cost. Few countries, other than those upon the North Atlantic, have had the energy to survey coasts, but Great Britain, and, to a much smaller extent, other countries, have surveyed wherever throughout the world it best suited their commercial interests. During the fiscal year 1903, United States vessels made surveys in the North Pacific Ocean, in Gulf of California and off the coasts of Brazil, Cuba, China, the Philippines, Hayti, the Aleutian Islands and Samoa. Many of the surveys of distant and unsettled shores have been very hastily and incompletely made, and there is a vast deal of work yet to be done before the combined action of all governments will have given to the mariner accurate knowledge of all shores. The United States is resolutely working away to make charts of the whole world, but it is quite as much a war measure as a commercial one.

The best of maps and charts are useless at night unless the shore is made visible and this the lighthouse does. The buoys upon hidden obstructions and the outlines of coasts are superceded at night by carefully arranged lights that are now maintained by all civilized nations. By keeping in a certain indicated relation to certain carefully described lights it is possible for the pilot to know the exact location of his ship, and follow a narrow and tortuous channel almost as well by starlight as by daylight.

The navigator is informed by charts and bulletins of existent dangers, and through the Weather Bureau he is warned of dangers to come. The exact nature of the weather is hard to predict in advance, but pronounced storms so uniformly announce themselves that during the past six years no protracted storm has reached any American port without being signalled well in advance. The United States Weather Bureau publishes storm warnings on all coasts and maintains two hundred and fifty displaymen. Messengers are often sent to vessel masters, and the system is so well organized and equipped that a bureau report can reach all vessel masters in the ports of United States within an hour after being sent. The importance of this service may be seen when it is known that there are constantly afloat on the Atlantic and Gulf Coasts of the United States thirty million dollars' worth of shipping and thousands of human lives.

Even in midocean the vessel is not beyond the care and the statutory guidance of governments. A sufficient amount of knowledge has been, and is being, collected to make profitable the publication of permanent and temporary charts of the open sea. Here the chief dangers are those of collision with ice, ships, derelicts (abandoned wrecks) and other floating objects. This danger is infinitely increased in foggy weather. The United States Government publishes charts of the North Atlantic Ocean and of the North Pacific, and owing to the fact that the ice and derelicts never remain in one place and the fogs change with the seasons, these charts become obsolete so rapidly that they are published monthly. The information that they contain is collected by sea captains. Every captain who comes to an American port is expected to report to the officials of the hydrographic office every obstruction to navigation that he has observed. Arrangements have recently been made for these reports to be cabled back to the United States from some foreign ports. By putting togther many of these isolated reports, the movement of the ice fields is easily traced, and the derelicts can be followed in their paths across the ocean. Important derelicts, ice floes and even dead whales are put upon the chart of the month, and the trans-Atlantic liners are sometimes delayed in sailing that the captain may have the latest ocean chart. Nineteen hundred voluntary observers are now making reports to our government of weather, storms and fogs at sea, and these elements, too, are represented upon the charts. In addition to the floating obstructions, the chart for any particular month gives the track followed by a large number of storms that have occurred in that month in preceding years; the relative amounts of fog that may be expected in certain regions, the prevalent wind force and directions, the ocean currents, the variations of the magnetic needle from the true north and, lastly, the exact routes to be followed by both steamers and sailing vessels in making their various voyages across the ocean. The monthly chart has recently been supplemented by a weekly hydrographic bulletin, distributed free of charge, and bringing the information down to the very latest date. Mariners so appreciated this that by their reports it was possible to add to the warnings the exact locations of fifty new dangers per week during 1903. This, along with much other information, is distributed and collected in the United States through the sixteen branches of the hydrographic office located in the leading ports of the country. The captains who make these voluntary reports receive in return free copies of such pilot charts as they need.

If a derelict continues in the paths of ships, and is not rescued for profit by some wrecking company or private individual, a government vessel, usually a revenue cutter, may be sent to find and blow it up with dynamite.

Governments also do real police work. Piracy, probably the greatest bane of ocean commerce from its inception until far into modern times, has practically disappeared through the vigilance of nineteenth century navies. A century ago the Mediterranean was still infested, and pirates yet linger in the China Sea, where the native craft only are selected for victims.

After showing and clearing the way to and across the high seas, governments still have regulations for the actual operation of the ship when far from land In a fog the vessel must go at half speed, and she must sound a fog horn at such intervals and for such periods as will will show the kind of vessel, and, if a sailing vessel, whether she is tacking to starboard or larboard, or going straight ahead. But the most lengthy regulations are those applying to signalling.

Fifty years ago the problem of communication between ships had resulted in about ten different sets of private signals. From this condition of chaos, order has arisen through the adoption of an international code, made for the British Government by a British commission, and adopted first by France and then, like the postal union, by most of the nations of the world. By a code arranged from twenty-six flags corresponding to the letters of the alphabet, any kind of necessary information can be communicated from ship to ship, or ship to shore, whenever the distance and weather permit flags to be seen. The regulations also provide that by hoisting certain flags in certain places, the vessel shall always give out certain information concerning herself. By this means an observer can tell at a glance if the vessel is about to sail, if she is loading dangerous explosives, if she wants or has a pilot, or if she is in distress. If the distance is too great for flags and colors to be seen, there is a second and less efficient system in which shapes are used, and by arranging squares and circles in certain positions some signalling can be done. By night rockets and lights are used, but owing to the impossibility of variety, the amount of signalling that can be done by this means is very limited.

Lastly, when all regulations and aids have failed, and the ship is driven upon the coast, there is the life saving service to save the passengers and crew from drowning, and, if possible, the property from destruction. The leading European countries maintain life saving stations, but the United States is the only country that also patrols its coast. There are two hundred and seventy-one stations upon the shores of the United States, and thousands of miles of beach are patrolled nightly in all the storms of winter. Upon coasts like those of Long Island and New Jersey, that project far into a much travelled sea and are near a focus of world trade, the stations are only three miles apart, but upon less frequented coasts they are placed only at dangerous points; the Gulf of Mexico having but eight and the entire Pacific Coast sixteen. The patrolman carries lights, and often safely warns vessels away from dangerous points, and if the vessel is in distress upon the shore the life saving crew, with their life boats, life lines and breeches buoys are such sure rescuers that shipwreck upon the American coast is scarcely more dangerous to life than some hazardous industries. Since the inauguration of the present service in 1871, there have been 13,379 disasters, involving 99,084 persons, of whom 98.9 per cent. or 98,081 were saved. Of the vessels and cargoes, valued at two hundred and one million dollars, one hundred and fifty-eight million dollars worth were saved.

PART III.—Harbor and Port Facilities.

CHAPTER XII.

PORTS AND HARBORS—PHYSICAL EQUIPMENT.

Ports are places where ships transfer their cargo to or from the shore, or ports may be called the connecting points between the trade routes of the land and those of the sea. Ocean vessels are loading and unloading their cargo in such a variety of places, good and bad, safe and unsafe, that it is impossible to give a less general definition of a port than a place where vessels load and unload.

The crudest kind of port work requires some break or unevenness in the shore line, and in some countries the commerce is greatly handicapped because a long, straight and unbroken coast gives the inhabitants of the land no opportunity to establish connections with the sea, except under conditions so precarious that ocean commerce cannot prosper if, indeed, it can exist.

Ports are all alike in that they require some improvement before they can be satisfactorily used for commerce. The extent of this improvement varies greatly, depending as it does upon the nature of the shore, of the commerce, and the amount of money available for harbor works. These artificial aids may be merely wooden landings for row boats, or they may be so extensive as to change an open harbor into a closed one with piers and wharves along which the largest ships may lie and discharge cargo by electricity.

The usefulness of a coast for port purposes, and the amount of labor required to improve it, depend almost entirely upon a simple geologic factor in its history. If the coast has sunk it is filled with harbors. On coasts that have long been stationary or slowly rising, the rivers and shore currents tend to fill up any irregularities of the coast with materials eroded from the land. On a coast that has sunk, the sea has flowed back into the lower river valleys, and the wider parts of these drowned valleys often make excellent harbors. For instance, New York, Hampton Roads, Chesapeake Bay, the St. Lawrence, San Francisco Bay, Sydney (New South Wales) and all the harbors of Great Britain. If it so happens that, in addition to sinking, a coast has been glaciated, it is so carved up that it makes an almost continuous succession of fine harbors. Examples are found in the coasts of Norway, Scotland, Ireland, Maine, Alaska, southern Chile and New Zealand. These contain enough harbors for the world, but their poor location makes most of them useless to commerce. They are not adjacent to centers of human activity.

All ports may be divided into two classes: (1) open roadsteads and (2) closed harbors.

(1) Open roadsteads are ports which lack the protection of encircling land, where storms from some point or points of the compass may drive the vessels to destruction upon the shore. In such exposed places the water is often rough enough in normal weather to make it inexpedient to bring the vessel alongside a pier, and so piers are not often built. Such ports are to be found below the limit of the ancient glaciers, and below the stormy, cold temperate zones with their uncertain weather. An open roadstead in the North Atlantic would be liable to destructive storms from all points of the compass at any season of the year, and it is far too dangerous and uncertain a place for the accommodation of modern commerce. The open roadsteads usually occur along shores with more settled climate; in the subtropic and tropic zones, where the trade winds and monsoons give the climate a regularity that can be depended upon. Open roadsteads are, therefore, common along the even coasts of South America and Africa, in Central America, southern Asia and the East Indies.

The open roadstead costs little, but labors under disadvantages. In nearly all cases the freight is unloaded, not directly to the land, but into small boats that go out to the ship. This method is troublesome for heavy goods, and under the most favorable conditions it necessitates an extra handling, and merchandise is often injured by sea water and sometimes lost as the small boat attempts to reach the land. In the port of Buenos Ayres, before the recent expensive improvements, the water was extremely shallow, and vessels had to lie several miles from land. Freight was carried back and forth on carts having very high wheels.

The open roadstead is further handicapped because, owing to the roughness of the surf, it is often impossible for a coasting steamer to land the goods at all. The steamer must choose between waiting for good weather or continuing upon her voyage. But waiting means irregularity of service, and irregularity is strenuously avoided by steamship lines. So the small open roadstead port usually misses the call of the steamer when the weather is bad. Sometimes a consignment is carried from New York to Caribbean ports in the same vessel, a second and even a third time, when the trade wind blows strongly, before it can be landed. If the amount of freight is very large the vessel must, of course, wait. During the continuance of rough weather, all loading operations in open ports must stop. The port of Valparaiso is open toward the west, and a strong west wind brings commerce to an absolute standstill. This enforced delay amounted in a recent year to one hundred and thirty-four days, causing a total loss to shipowners of tens of thousands of dollars.

(2) Closed harbors offer by far the best advantages for the growth of trade. A small body of water nearly surrounded by land may be exposed to the wind, but it is safe for ships, because the danger to them comes from the motion and blows of waves, and the formation of dangerous waves requires several miles of unobstructed water. The closed harbors are afforded by bays and river mouths. Considered

merely as safe places for ships the bays are much more numerous than the river mouths. They are usually easier to enter and safer, but most of the great commercial ports are on rivers because a great port must, in addition to a good harbor, also have access to the interior. This is best afforded by the navigable surface and easily traversed valley of a large river.

The value of river mouths for harbors is vitally dependent upon the tide. This influence may be classed under three heads: (a) rivers with little or no tide; (b) those with moderate tide; (c) those with great tides.

(a) Rivers with little or no tide are, at their mouths, constantly on the level of the sea. This permits the river to form a delta, fill its channels with silt and spread out fan-shaped into a multitude of shallow wandering streams. The best examples of a tideless sea is the Mediterranean. It has no river harbors, while the north of Europe, with tidal coasts, has river harbors almost exclusively. The rivers flowing into the Mediterranean are all closed. The Rhone, the Po, the Nile and the Danube are in some part navigable rivers, but all are closed by nature to the entry of large vessels. A canal has been cut at the mouth of the Danube to avoid the delta, but it is useful to river steamers rather than ocean steamers, and no important port has resulted. The commerce of the Mediterranean is, therefore, compelled to seek refuge and land connections in bays along shores where suitable bays are scarce. All the leading harbors, Marseilles, Genoa, Naples, Trieste, Algiers and Alexandria were originally open roadsteads that have been protected by costly breakwaters or moles. Similar improvements are planned for Barcelona.

In addition to protecting otherwise open roadsteads the breakwater or jetty is also used to give greater depth to the mouths of rivers having slight tides. The entrance to rivers or lagoons of this class is usually blocked by a sand bar a few feet beneath the surface of the water. The slight tide in running out carries the sediment a short distance beyond the river or lagoon mouth, and, where the current stops, the earth is dropped in the form of a semi-circular bar. The jetties narrow the opening and extend it out to sea, and the force of the current, being confined within narrower limits, cuts deeper and carries the sediment out to deeper water. This method will require the lengthening of the jetty at intervals as the accumulating sediment forms a new bar. This kind of improvement seems to be particularly applicable in the Gulf of Mexico, where the rise of tide is about two feet. Jetties have deepened the Mississippi from seventeen to thirty feet, and by the same means the shallow ports of Vera Cruz and Tampico, Mexico, have been doubled in depth, and Mexico has entered upon her commercial existence.

(b) Moderate tides, those between five and twelve or fifteen feet, make the best river harbors, because the river mouth is kept open to a good depth, and the rise and fall of the tide is not a serious inconvenience to ships at the wharves or piers. In nearly all cases the water at the entrance is only deep enough for large vessels to enter during two or three hours at high tide, and some dredging is commonly resorted to to make this easy. Harbors of this type are very important in the world's commerce. Among the important examples are the Atlantic ports of United States, Shanghai, Calcutta, Hamburg, Bremen, Rotterdam, Southampton, Glasgow. The streams in which these harbors lie usually require some deepening for the largest vessels, but the cost of dredging is less than that attendant upon the improvement of the rivers without tide or those having great tides.

(c) Great tides are those from fifteen to forty feet, and while they serve to scour out the sand bars, they deposit them further at sea, and it is practically impossible to keep large vessels afloat in the river during low tide. This difficulty was unimportant with the small sailing vessels in use two centuries ago, but the modern steamer has such great size and weight that lying on the bottom would often break the hull. This danger has been avoided by the costly means of making in the solid earth, along shore, artificial harbors, usually called docks.[8] An excavation is made, enclosed with solid masonry and with water-tight gates like canal lock-gates to hold the water in during low tide. At high tide the gates are opened, vessels come and go and the gates are then closed to hold the water and the ships at the high tide level. Fortunately for the advancement of commerce, great tides are uncommon, and only occur in ports in Great Britain, the English Channel and the Bay of Fundy. There are several exceptions in Great Britain, but the greater part of the foreign commerce of the United Kingdom passes through ports with harbors of this type, as London, Liverpool, Hull, Bristol, Cardiff. Across the channel are other examples in the harbors of Havre and Antwerp, but the latter city has only a part of its harbor within locks, another part being in the river itself, which has become available by the use of modern unloading appliances.

These artificial or dock harbors offer every desired convenience for the handling of freight, the one drawback being the great cost of construction. This is again offset by the permanence of the structure. Piers like those of New York and Philadelphia, standing on piles, must be renewed from time to time, but, according to a New York shipowner, the total cost of building them and keeping them in repair is less than the interest on the capital required for stonework like that in the harbor of Liverpool. That statement is probably too strong, but it is at least suggestive of relative costs.

The ideal commercial harbor probably finds its nearest approach in that of New York. It is a closed river harbor in ad rowned valley. It is not obstructed by ice. A great river gives a highway to the interior, and with its deep and widened mouth, half estuary, half bay, holds enough water to enable a moderate tide to scour and keep open a sea entrance with but little dredging. Further than this the river is (and for an ideal harbor must be) wide enough to permit piers to be built out into the stream at right angles to the shore. By this means the space available for ships along a given amount of shore line is increased more than fivefold.

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[8] In some of the ports of the Bay of Fundy small vessels are kept at the desired level by being supported on cribs, which are nothing more than strong scaffolds alongside the pier at such a level that at high tide the vessel can float into place. This method of support, if physically possible, would be injurious to vessels of the largest size because of the uneven strain to which the hull would be subjected.

If a river, otherwise usable, is too narrow for piers, the vessels must lie in single row lengthwise along the shore. Upon this extravagant use of shore line no commercial city can depend entirely, because the ships that carried its commerce would be compelled to stop miles down stream to find shore space to unload and receive cargo. The Maas at Rotterdam is five hundred and forty yards wide, and the Elbe at Hamburg is little better; while the Hudson at New York and the Delaware at Philadelphia are each nearly a mile in width. A comparison of the maps of the harbors of Hamburg and Rotterdam with New York and Philadelphia will show at a glance the amount of work that man has been compelled to do because of the narrowness of the two European rivers. Instead of piers going into the stream seven hundred feet as in Philadelphia, a single row of ships lies lengthwise along the shore, and artificial harbors hundreds of acres in extent have been dug in the adjacent meadows to enable the shipping to be accommodated within the port.

CHAPTER XIII.

METHODS OF PORT OWNERSHIP AND CONTROL IN THE LEADING COMMERCIAL COUNTRIES.

As has been pointed out in the chapter on ocean freight rates, the public, the community, has an inalienable interest in harbors, and this interest is always protected by some form of public activity. The forms taken by this activity are extremely varied, ranging from the mere umpiring and policing of private citizens to the absolute national ownership and operation of the harbor and its facilities. Private ownership finds its field of activity in the Anglo-Saxon countries, where individualism has long had opportunity to exert itself. Upon the continent of Europe private ownership has almost no foothold whatever, and the municipality, the state and the nation are the powers that own and act.

Between these two extremes the great variety in methods of harbor management arises from differences in political concepts and methods of government, from differences in the wealth and commerce of communities and the relative local importance of that commerce; from differences in the physical requirements of harbors and from the dual nature of the harbor itself. A harbor has first of all a channel, a highway which like any other highway must be public property. Secondly, a harbor usually requires and has wharves and other structures where the ship must unload its cargoes. These shore structures must, for the time being, be the exclusive property partly, or entirely, of the person using them. The channel offers possibility of varieties in jurisdiction, the wharf yet greater varieties of ownership and control.

Individualism has done many great things for the world and for commerce, but it has not made the most efficient of seaports. The task is too great and many-sided. The problem is well stated in the words of an American consul after residence in one of the best ports of Europe.[9] "A great and successful sea port can be built up only by united effort. The docks, quays and necessary mechanical appliances are part and parcel of the port and harbor. How the harmony, order and method so essential to the development and successful administration of vast and varied interests can be secured unless the sea port and its harbor service in their entirety be subjected to the direction of one central controlling power is, indeed, difficult to understand."

As stated above, this "central controlling power" may own and operate, down to the smallest details, or it may only lay down rules for the guidance of others. Both of these methods are to be found in America, the latter predominating, with the tendency toward increasing public control. All channels useful for interstate commerce are under the control of the United States Government, which marks out a pier head line. Within that line the state is supreme, and the general consciousness of this supremacy is well voiced in the words of the constitution of the state of Washington, which declares that no water areas beyond high water mark shall be sold or relinquished by the state, "but such areas shall be forever reserved for landings, wharves and streets, and other conveniences of navigation and commerce."[10]

The State of California has a harbor board, which for forty years has controlled, owned and operated the harbors of the state which are, of course, almost entirely limited to San Francisco. In this state action, particular pains were and are taken to avoid giving special privileges to any person or corporation. New Orleans passed through some interesting developments to a similar result. In 1891 the municipality which had been in charge of the management leased a large part of the harbor to private parties for a period of ten years. The experiment was unsatisfactory, and after five years of declining commerce the State Legislature unseated the lessees and placed state harbor commissioners in charge. This commission has made improvements by borrowing money on the security of the wharfage incomes.

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[9] U. S. Consul Reque at Rotterdam, see Rep. Mass. Com. on Docks and Terminal Facilities, 1897, p. 280.

[10] Mass. Rep. on Docks and Term. Facilities, 1897, p. 37.

The Atlantic ports of the United States are not so simple in their arrangements. New York has a combination of municipal and private ownership. A dock board, established in 1870, as a part of the city government, builds and manages the city docks and enforces the general rules covering the private terminal facilities. The city property is leased to private individuals and corporations for limited periods. In Philadelphia the private interests have a stronger hold. All wharf property, except at the ends of streets, is private. A few years ago, when systematic improvements were made, a new pier head line was established farther out into the river; the river-front avenue was widened and the city government gave specifications for the extension and improvement of the piers, and the city declared its right to condemn the property of private owners who refused to comply within a set time. It has not, however, been deemed necessary to take property under this act. Another evidence of public right in this stronghold of private interests is the power of the harbor master to assign an incoming ship to any private, but temporarily unused wharf.

The weakness of the Philadelphia, or even of the New York situation, is that the "central controlling power" does not prevent confusion of ownership, and the accompanying difficulty of carrying out a far-seeing system of construction which makes possible systematic operation such as one finds in the unified ports of Europe. There scores of cranes upon miles of quays are all operated from the central power plant of the comprehensive system having all the advantages usual to wholesale operations.

European harbors are, upon the whole, much more systematized than those of the United States. Marseilles possesses the only private dock company on the continent, and to stop the dissatisfaction resulting from its exactions the city government built competing municipal docks twenty-five years ago. Copenhagen has a non-profit-paying free port company, and everywhere else the city and state are supreme in port arrangements. In Russia and Hungary the royal government is directly responsible. In France the central government owns the Havre harbor, but the city controls and operates it. In Ghent, Antwerp and Rotterdam the municipality owns and directly operates everything. Hamburg and Bremen, as independent states, provide both channel and harbor with all its facilities, and also own many warehouses within their free ports. In all of these harbors of northwestern Europe plans of extension include the enlargements for a distant future, and the location of docks, wharves, warehouses and railways is planned with the greatest forethought. The operation of cranes and derricks is by central plants distributing power over large areas by hydraulic or electric systems. In no other ports have commercial facilities reached so perfect a stage.

Great Britain has in Bristol and Preston efficient examples of municipal ports, but the same efficiency and unity is attained by the public trust, which is the most common and thoroughly typical British form of port management. Britain began a century or more ago with Parliamentary grants to private companies to build docks in the various ports as the need arose. These companies, operated for private gain, and supported by dues from the ships that used their facilities, were usually unable to make the necessary improvements that were required after the coming of free trade and the introduction of steam into ocean navigation. The property of the embarrassed companies was sold, sometimes to railway companies, to be incorporated into their systems, at Bristol, to the municipality, but usually to a public trust.

The public trust is a corporation authorized by Parliament, and granted extensive powers in the ownership, management and improvement of a particular harbor. In its make-up and management the public trust resembles the board of trustees of an American university or charitable institution. It is an honor to serve on the board, the members do not receive salaries and the enterprise does not make profit. It is run solely for the public good. The board of trustees has a different representation in every case, the composition being laid down by statute, and no two are alike, because an effort is made to get wide and uniform representation of the various local interests to be affected. The British Government and the city government usually name representatives, as do commercial organizations like chambers of commerce, boards of trade, shipowners' associations and the payers of harbor or dock dues. The relative strength of the institutions and interests represented, decides the number of their representatives on the board. These trusts take over the property of the old companies, and make improvements by borrowing money at low rates on the security of the docks and their incomes, and sometimes upon the security of the municipality. The fixed charges are thus much lower than for an ordinary private corporation. There are no salaries to directors, no dividends to stockholders, only the payment of interest on bonds, which have low interest rates because of the excellent security.

The scope of public trust activity sometimes includes the channel as well as the harbor with its docks, cranes and warehouses. An American city of a million inhabitants will clamor, pray and indefinitely wait for national aid in the form of some hundreds of thousands or a few millions for channel improvements. A British city sturdily borrows the money, makes the docks, digs the channel and then proceeds to collect tolls and pay the indebtedness. The city of Liverpool, with 600,000 inhabitants, has a harbor trust that has made expenditures of more than $200,000,000 within forty years. It is paying its indebtedness, reducing its rates of dues and the community is pleased with the service it receives.

The public trust is in some respects the most desirable form of port control. It is like municipal and other forms of public control, in that the object is the development of trade, the improvement of facilities and the cheapening of rates, whereas in private hands the object must ordinarily be the greatest obtainable return. The public trust exceeds all other forms of control in the union of responsibility and interest in the same hands. With a port under the care of the national government, it is true it is to the nation's interest to maintain port efficiency, but it is an indirect interest not always visible and many other questions must claim the legislator's attention, and warring local interests may divert legislation to unworthy objects. Even under municipal control, harbor and commercial matters must be passed upon by people who are interested only in education, sanitation, transportation, municipal finance or parks, and finally by many more who are not especially interested in or informed upon any phase of municipal activity. The public trust cuts right to the heart of the matter, lays aside all these disinterested, uninformed and delaying parties, and places harbor control in the hands of those who have harbor interests; yet those interests are identical with those of the city at large. Selected men from among the shippers, the shipowners and the commercial groups within the city are placed in charge. They have knowledge of what is needed, they have untrammeled power to act when necessary, but they are limited in that the facilities provided must be open to all, and all benefits accrue to the public. There are no profits to go to private individuals, and money can be borrowed more cheaply than by a private company. Action can be prompt and at the same time the motives for and the possibilities of mismanagement are reduced to a minimum.

Great Britain has also a considerable number of survivors of the original class of ports in which the docks are privately owned. The channel is almost invariably cared for by a public board, much like the public trust, and deriving its revenues from tonnage dues. Examples of this are the Southampton Harbor Board, the Humber Conservancy, the Thames Conservancy. It is a rather remarkable fact that

London, the world metropolis, has docks owned by private companies with the object of paying dividends. These companies have outlasted those of Liverpool, Glasgow and Bristol, because of their early start, great strength and the richness of the commerce they served and taxed. But they are approaching the end of their experience. They linger hopelessly on the verge of bankruptcy, powerless to make improvements for the want of which the commerce of the port languishes. Negotiations now in progress promise to lead shortly to the formation of a public trust, combining the powers and property of the four bodies that have managed the channel, the piloting, the docks and the licensing of lightermen. This new harbor trust will, if created, be able to borrow funds and make needed betterments.

Prosperity attends one class of privately owned (but publicly used) docks in Great Britain—those owned by and operated as a part of a railway system. By this means the London and Southwestern Railway has made Southampton a great port, and has won for itself great freights. Grimsby on the Humber, and several other of the smaller British ports, owe their prosperity to that form of railway activity which has built or bought and improved docks to use as terminals. The private dock company, standing alone as a dividend-earning venture, has practically ceased to exist in Great Britain.

The public has for decades been superceding private activity in the ports of all countries, and yet the impelling force has been competition. Any improvement that puts one or two European ports distinctly ahead of all others, brings it prosperity at the expense of its rivals, and they are compelled to see their commerce decline or follow suit in improvements. Consequently private interests have been brought out, administration has been put upon its most efficient basis, and almost every port of Europe shows active progress in improvements and extensions. America is not yet so active or so far advanced, because of the smaller part taken by foreign commerce in the economic life of the people, and because of better natural harbors.

CHAPTER XIV.

THE HANDLING OF FREIGHT.

As soon as the formalities of entry are completed, and a ship has come to rest at her moorings or her dock, the operations of loading or unloading begin. Here the ideal is to transfer directly by mechanical power the inanimate freight from water conveyance to land conveyance or *vice versa.* In the general application of machinery to commerce this field has received its share of attention, and in some forms of commerce the adaptation of freight-handling machinery is wonderfully complete, and in others, because of the necessary limitations of harbors and the peculiarities of commerce, it is surprisingly incomplete.

It is a simple process to move freight by machinery from a vessel to a car or wagon alongside, but many hindrances arise in practice to prohibit this much-desired simplicity, especially in miscellaneous cargoes. On shipboard freight is stored in the holds, in such manner that it will pack in as tightly and compactly as possible. It is, therefore, loaded with primary regard to the shape of the packages, and particular shipments are sometimes separated and cannot be unloaded together. Direct transfer is not expedient in such cases, and if it were attempted the shifting of cars and the waiting for wagons would often cause excessive delay. Ships are too valuable to stand unnecessarily idle, and they are so much larger than cars or wagons, and load so rapidly, that it is impossible under favorable conditons to bring goods from any considerable distance as fast as they can be put on shipboard, or to remove them as rapidly as they can be discharged. The consequence is temporary storage at or near the point of loading and discharge. If prompt transfer to distant points were physically possible it would often be unwise and uneconomic to do so because of the irregular labor that would result from rushing the work when a ship was at the quay, and consequent idleness in the intervals. It is the common practice to load and unload the vessels as rapidly as possible, while the packages, before loading and after unloading, lie in piles and groups on the floors of the freight sheds that stand upon the quays of all important harbors. Here consignments can be counted, inspected and taken away at the convenience or delivered at the convenience of the consignee or the shipper. Sometimes goods may be stored for a considerable period, and in some European ports the freight sheds alongside the ships become extensive warehouses by the addition of a second story, as in Liverpool, or third and fourth, as at Manchester and Rotterdam, and even a sixth story as in Newcastle.

As stated above, this sorting, inspecting and storing, and the consequent hand labor are necessary for *general cargo* and case goods. Machinery can be more extensively and exclusively used in the handling of coarse staple articles of uniform shape, like grain, coal and ores. These two general classes of cargo have resulted in the development of two classes of freight-handling machinery: 1. General types for handling miscellaneous cargo. 2. Special types for the handling of particular staple articles.

1. General types may be divided into the two headings of (a) ship machinery and (b) land machinery. (a) The ship machinery consists of a number of small independent engines, each of which winds a rope or chain over a drum or windlass. These engines, called winches or donkey engines, are distributed about the ship, one or two being by every hatch (opening into the hold). They are under perfect control, stopping and starting almost instantly and running rapidly, and turning a drum upon which a rope is wound. By the liberal use of pulleys these moving ropes may be made to lift or pull in any direction, and the ship is able by her own machinery to lift her cargo from the hold and put it on a quay or overboard into a boat alongside, or take it from boat or quay and lower it to the hold. Far-

ther than that, the steam winch on deck may be made to push heavy freight into place in the hold as well as draw it out. Most of the numerous spars that are attached to the rudimentary masts of an ocean steamer serve no other purpose than to support the pulleys that assist in the handling of the cargo.

(b) As the ship machinery can only operate a few feet from the ship's side and can only swing the freight overboard, it is often better to have some or all of the work done by land machinery, which can be built on a larger scale and which has a wider reach. The most prominent, numerous and useful of these appliances is the moving crane or derrick. They are made in several designs, but practically all are on tracks alongside the quays, and can be moved back and forth at convenience. They have a long arm that reaches over the ship, takes its cargo (usually from the deck) and swings it from the ship to a railway car, a wagon or under a freight shed, as the case may be. Sometimes the railway track or tracks between the freight sheds and the ship pass beside the cranes, sometimes under them. Sometimes, as at Rotterdam, the cranes lift the freight from the deck of the ship to the second, third or fourth story of the warehouse alongside. The lifting power varies usually from 2,000 to 5,000 pounds. The power is sometimes supplied by individual engines, sometimes by electricity, but usually by dydraulic pressure. In the European ports the cranes belong to a part of the general system of harbor works. One or two central power plants pump the water, which flows under pressure through a pipe system miles in length and operates scores of cranes besides being used to shift cars and run elevators and lift freight in warehouses. These hydraulic cranes are not strong enough to lift some pieces of the heaviest freight, such, for example, as the shaft of a steamship, cannon, heavy machinery or a circus elephant. Every port of importance has one or more heavy cranes, lifting from ten to fifty or eighty and sometimes over one hundred tons. These may be stationary, and the ship must come alongside, or they may be on large floats that can be towed about the harbor and, without disturbing the ship, take off the heavy freight and carry it to any desired point within the harbor, and lift it to the shore.

Ocean freight, after being discharged from the ship, must often be transferred to another ship in a distant part of the harbor, or to some other wharf in which the consignee has an interest, and as the ship does not often move from wharf to wharf, the freight must be taken from one part of the harbor to another. This is done by lighters (small open boats) and it is done by wagons. The amount of this port transference by an intermediate conveyance is, indeed, surprising. It is estimated[11] that in the docks of the great London dock company 75 per cent. of incoming cargo and 80 per cent. of outgoing passes over the ship's side to or from lighters. Conditions are not dissimilar in New York, where 10,000 lighters are employed. In some European ports, especially Antwerp, where the docks are grouped rather than arranged in long lines as at New York, a vast amount of work is done by drays and wagons, built in all manner of shapes and owned and operated by wealthy corporations having no other business. This intermediate work with lighter and wagon is usually to get the freight from one ship's side to another or to a quay, where it is again taken hold of by ship or shore-loading machinery.

The use of wagons has resulted in the devolopment of special machinery for loading them in ports such as Liverpool, where the quay surfaces are on the ground level. Hamburg avoids this difficulty by having the floors of freight sheds at the height of a wagon body, and within the reach of the derricks that lift goods from the holds of ships. Ordinary freight can be moved from place to place, short distances, on a level by the use of hand trucks, but the difficult work of loading upon a wagon heavy articles, like 500-pound bales of cotton, is accomplished by using a small steam derrick mounted upon wheels and moved from place to place like a wagon. It will pick up cotton bales or heavy boxes, and heap them ten feet high upon the tops of drays in a way that human labor could not duplicate. Heavier work of this type, lifting logs, iron and machinery, is sometimes done by stationary derricks, having very long reach, so that when located in the center of a yard adjacent to several docks, one derrick can cover a wide area and do a large amount of work.

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[11] See Royal Commissioners' Report on Port of London, 1902, p. 78.

2. Special types of freight-handling machinery come much nearer reaching the ideal of substituting mechanical for hand labor. The articles handled are uniform in character, and are required in such quantities that special cars, vessels, wharves and warehouses are usually built for their accommodation. The leading articles in this class are (a) grain, (b) coal and (c) ores.

(a) The most elaborate of these special types of freight-handling machinery have been developed for the trade in grain. Wheat often goes from the farmer's wagon into the flour barrel hundreds or thousands of miles away without even being touched or lifted by human hands. The facilities in the United States and Canada illustrate the most advanced types of this class, which is not so well developed in all exporting countries.

The American farmer hauls the unwinnowed grain to the receiving elevator (warehouse) at the railway station, and empties the sacks over the wagon side into a chute (called boot) that leads to the basement of the building. Here mechanism takes charge. Up by steam and down by gravity, such is its future history. Within this first building the grain may be cleaned, sorted and mixed by steam power, which lifts it from basement to attic, weighs it and places it in bins for storage. By the force of gravity it runs thence into sacks for loading, or it may run loose (in bulk) into the cars alongside the elevator. The cars may go to the flouring mill, to the port of final shipment or to the terminus of an inland water route, such as Chicago. West of Chicago it is commonly taken from the elevator in sacks, which slide down chutes into the cars alongside the building. When they are to be unloaded they are cut or untied and the contents poured out the car door into the boot to a belt conveyor. When carloads of loose grain are to be unloaded, the same process is repeated, but machinery is used. A power shovel is so attached by a rope to a winding mechanism that a man may draw it back at will, but when he stops the shovelful of grain moves forward and keeps on until it reaches the boot of an elevator leg. With this device two men can unload from the cars 30,000 bushels per day.

The most convenient and rapid method of loading ships is to bring them alongside of a grain elevator on a pier, where the grain runs directly from the bins into spouts discharging into the holds of the vessel. This is the common method at the lake ports, and they are unloaded by the endless bucket belt (elevator leg) reaching directly from the elevator into the hold of the ship. At the seaport the vessel may, however, be loading other cargo, and time can be saved if the grain can be brought to her side. At the general cargo wharf floating elevators do this work. They are top-heavy looking structures, and carry grain from the main elevator to the ship. They carry it in the hold, elevate it to the top of their tall towers and let it run into the vessel's hold as from the main elevator. They are, of course, very unstable craft and remain close to the protection of the shore.

In cases where the elevator must stand back from the waterline, a belt conveyor, a wide belt, running horizontally with grain lying upon it, carries the grain from the warehouse to the ship an eighth of a mile away.

Once across the ocean the method of unloading grain depends upon the method of carriage. If in sacks, as is sometimes the case, it is usually taken up by the ship's hoisting machinery and often lowered or slid down a chute into a boat alongside. This is particularly true of the grain that goes to Holland, Belgium and Germany. It is nearly all consumed in the Rhine Valley, and carried in the canal or river boats, which go directly to the mills in the low countries, or transfer to railways at the Rhine ports. The more important Rhine ports have unloading facilities similar to those of good European seaports. If the grain goes in bulk (loose in the compartments of the ship), as it usually does, a belt unloader is very commonly used. This method of carrying and unloading is typical of the British ports. The vessel comes close alongside of a freight shed. A belt with buckets raises the wheat from the hold and drops it on the wide surface of a rapidly-moving belt conveyor, which carries the grain in a continuous stream into the building, whence it may be distributed by any means at hand.

(b) Machinery for handling coal does not have to perform so many processes as is the case with grain, nor must the product be so carefully handled. The commercial handling of this article is limited to simple transfers between railroad cars and vessels, and from these to the merchant's coal heap, along with occasional reloading of cars from piles where it has been stored. Coal comes from the breaker at the mine mouth in full loaded cars, and when it is for export from Europe, a common method is to dump it directly from the car into the ship. On the continent this is usually accomplished by the use of the "coal tip." The car is run upon a platform which is lifted up in a tower high enough to cause the coal to run down a chute into the ship when one end of the car is tipped up. By the method of car dumping commonly in use in Great Britain, the car itself is swung on a crane and dumped somewhat like a bucket is emptied. In Cardiff the coal is put on shipboard by a crane that swings a box-like receptacle, holding as much as five tons and depositing it in the ship's hold.

In the United States export coal is handled by two methods, depending upon the variety of coal. Hard coal will stand rough usage without crushing, and it is dropped through the bottom of the cars into chutes leading to the vessel lying beside a high wharf. The softer bituminous, coal cannot stand such rough treatment, and at the lake ports, where it is handled in the greatest quantities, the forty- or fifty-ton cars are dumped sidewise by a strong elevating machine, and the coal is caught in a number of sectional hoppers, which divide up the forty or fifty tons comprising the carload into receptacles that can be lifted into the hold of the ship by an electric crane. It is discharged from these steamers at the lake ports by the method in use for discharging ore, which will be described below.

Bunker coal, that is coal for the ship's own engines, is not always loaded so systematically as export or cargo coal. Owing to the arrangement of the machinery in the center of the ship, and the bunkers convenient to it, they sometimes are not convenient to loading by fast mechanical appliances, and are in these cases filled from baskets passed by hand over the deck of the ship or through a port hole from a lighter alongside. This is usually done at the same time that the cargo is being received.

(3) Ores are admirably adapted to being handled by machinery. Rough usage and water do not injure them, and these factors, the cause of so much care in the handling of grain and soft coal, can be disregarded in arrangements for loading, unloading and storing ore.

No other traffic in the world has arrangements for handling so perfect as has the iron ore traffic upon the American Great Lakes and connecting railroads. It is scooped up from the Michigan ore beds by steam shovels, which run on railroad tracks and deposit the ore in the cars alongside. The trains run out upon high piers, at upper lake ports, unload by gravity into ore pockets on the pier, high enough to allow steamers alongside to load from them by gravity. At the ports of discharge on the lower lakes, the ore is lifted from the holds of vessels by electric cranes, carrying five tons at a load. The bucket runs on a track on the under side of a cantilever support, which is held thirty to fifty feet in the air upon trucks that run up and down the water-front on heavy railway tracks. These cantilevers are sometimes several hundred feet long, and reach across several railway tracks and vacant spaces where the ore, if not wanted on cars immediately, may be dumped for storage in piles higher than house tops. With a cantilever crane at each hatchway, very fast time can be made unloading ore. Vessels having 6,000 to 7,000 tons of ore are often loaded in a few hours, and unloaded in the ten hours of a working day. This expedition in cargo transfer enables the vessels to be at sea and in transit a remarkably large proportion of the time.

At Bilbao, Spain, the greatest European ore shipping port, the method of loading is the same as at Lake Superior, but unloading in the United Kingdom is not as efficient as on the shores of Lake Erie. The cantilever crane, extending over tracks and storage yards, is not used. At Glasgow, one of the leading ore importing ports of Europe, cranes with swinging jibs reach over two tracks and have a capacity of thirty tons per hour, but the difficulty of supplying the small cars and getting them out of the way again ordinarily limits the discharge from ore vessels to 1,000 tons per day.

CONCLUSION.

CHAPTER XV.

TENDENCIES IN COMMERCIAL ORGANIZATION.

The general tendency in ocean commerce is toward more thorough and complete organization. This comes about from the general tendency of business and commercial progress as promoted by both individual and corporate activity. The action of governments in aid of commerce tends to the same result, although with less force than that resulting from the aggregate of private activity.

Organization evolves naturally from the general and rapid scientific and mechanical advance of the present. As man comes to know more and have more mechanical devices at his command, greater commercial organization becomes possible.

Ocean commerce is becoming more dependable, and the quality of dependableness is an essential to organization and must accompany its extension. Any increase of certainty increases the bounds of possible organization. This dependableness is of various kinds, and is due to many causes, most of which are world-wide in their effect, and of which some of the more important will be taken up in order.

1. *Safety of Navigation.*—Continued surveys are giving more complete knowledge of the seas and their dangers; the advancing knowledge of climate and of storms and their prediction is increasing the safety of voyages. The improving cable connections and the wireless telegraph distribute this information more widely than ever before. The increasing strength of ship-building materials and new devices of design lessen the number of accidents and minimize

their effects. The uncertain sail is being replaced by reliable steam. Plans can be made and carried out as never before. Trade by sea is coming more and more to resemble trade by land in these respects. It is probably true that delays due to weather, accident, and other unforseen causes are now as frequent in the internal as in the over sea commerce of the United States.

2. *Increased knowledge of maritime and commercial ditions* is almost as important as the reliability of the ship. Shipping should be reliable, but if anything has gone wrong it is essential that it be known at once. The telegraph keeps the ship owner in touch with maritime affairs in all sections of the globe. When accidents do occur to shipping the telegraph now informs the owner in a fraction of the time that must elapse before mail information could arrive. The number of cables and cable stations is steadily increasing, and the occasional use of the wireless telegraph arouses interesting speculations concerning the advent of a time when ships on any sea will at all times be as accessible for communication with their owner as trains upon a railroad system are to the officials of the road.

Increased telegraphic communication also facilitates the more prompt and thorough dissemination of news pertaining to crops and commercial and industrial conditions that are to be translated by the ship owner into freight to handle and voyages to make. This better knowledge of the location of shipping and of the prospective freight lessens the chances of mistakes in ship management which are sometimes so disastrous to the ship owner and disturbing to rates.

3. *Increased Speed and Shortened Routes.*—The world is being unified by the increased rapidity of connections due to faster vessels and new routes. Increased speed of vessels practically diminishes the size of the world and enables adjustment to follow change more quickly and therefore lessens the effect of change. The Suez Canal revolutionized the commerce of Europe with the East. It cut the

distance in two, opened a route that could be followed by the steamer, thus doubling the speed of the superseded sailer. The commerce shifted from luxuries to necessities, from valuable goods in small quantities to raw materials in large quantities.

The opening of the Panama Canal will complete this process for Pacific commerce by tapping that ocean from another direction. It will put the Pacific Ocean in quick connection with the Atlantic. So far as ocean commerce is concerned, the commerce of great regions on that ocean is cut off from the rest of the world by thousands of miles of steaming, or by costly railway transportation. The new waterway will give the Pacific the same relation to the Atlantic upon the West that the Mediterranean Sea and the Indian Ocean have upon the East.

With this new route diminishing the length of the voyage by half or even more, another large part of the world's trade will have its element of uncertainty greatly reduced. This same influence will affect the whole world through gradual increase of the speed of vessels.

4. *Greater Volume and Steadiness of Trade.*—There is possibility of better organization in commerce through the increase in its volume and through the change in the character of the dominant commodities, and the increase in the number of producing regions.

Commerce is getting an increasing solidarity, due to mere mass. Where fifty years ago one sailing vessel went there is now a fleet of steamers. The better vessel has given a cheaper freight rate, the cheaper freight rate has called in new and cheaper and bulkier commodities, and the railway has opened up lands in all continents for their production. By the law of averages, every addition to the number of districts producing a given commodity lessens the commercial disturbance resulting from local drought or disaster. When grain is shipped from each of five continents, shortage in one may be offset by surplus in another, and shipping is not disturbed thereby, because the same amount of work is to be done and commercial activities can be organized accordingly.

For the maintenance of evenness and organization in commerce it is quite as important to have steadiness of consumption as steadiness of production. This, too, is promoted by the increasing number of regions now engaging in world commerce. As the prosperity of each depends upon different conditons, they do not have their ups and downs together, and commerce has a more even flow.

As freight rates decline and the ton value of freight diminishes, the number of staple commodities increases. As a result any change affecting one commodity has less effect upon the general commercial movement. It is like mutual fire insurance in that it distributes the shock among so many shares that it is scarcely felt.

5. *Ocean commerce will be more dependable because its hold upon industry is steadily becoming more fundamental.* This is evidenced by the present tendency for the freight to be made up more and more largely of raw materials and food for the support of city populations. This gives it a stronger hold upon peoples, and will be affected less by depressions than when it was more largely composed of luxuries that people could, upon the pressure of hard times, dispense with.

6. *Steamship Lines are Allied with Railroads.*—The organization of ocean commerce is accompanying the organization of land commerce, is being organized with it as a part of extensive systems. The present period is one in which the organization of land commerce is making phenomenal strides. Railroads are being consolidated so that thousands of miles are under single managements. Traffic arrangements widen the practical working of these consolidations, and to complete the desired service, railways in both America and Europe have of late made steamship lines a part of their systems. This is often done directly, and also through alliances and subsidiary corporations. There is no reason to think that this influence which has

given such high organization and efficiency to some of the branches of ocean commerce will not continue until it includes a much larger share of the world's maritime trade.

7. *The Steamship Line Becomes a Part of Productive Enterprises.*—A line of vessels has now, in many cases, become a part of a great producing industry which has entered commerce to deliver its own produce. Iron, oil, and lumber companies, and several kinds of mining companies, are running lines of ocean vessels as a part of their enterprises. Even agriculture is entering this field, and tropical fruit companies are operating scores of steamers in the delivery of their product. This phase of industrial organization, involving, as it does, a part of the ocean carrying trade, promises to be largely extended in the future.

8. *The Action of Governments is Affecting the Organization of Ocean Commerce.*—Prevailing political theories are working away from unrestrained individualism toward increased public action for the general welfare. Governmental activity is increasing in all civilized countries, and in so far as it affects commerce, it usually paves the way for greater organization. This end is indirectly fostered by the large amount of effort being expended in the promotion of science and inventions among the people and in the direct increase and dissemination of knowledge. A most conspicuous example of the last is the survey and charting of seas and coasts. Governments are controlling, subsidizing, and at times directly participating in commercial activity.

Government control of ocean commerce requires a lengthy code for its expression, but occasionally it participates directly in commercial organization, especially in connection with harbor work. Harbors that are managed by many individuals are unsystematic or chaotic, and the degree of organization increases with the increase of government activity. The pronounced tendency in all the leading countries is toward more government control, and therefore more organization in this phase of commercial arrangements.

Subsidies for shipping are at the present time rising in importance as a part of commercial policy. Whether they take the form of direct aid or mail subsidy, they tend distinctly to extend the field of organization in commerce. Shipping companies are enabled to widen the field of their operations by establishing lines in regions where the commerce is at the beginning too meagre to support them. By this means the people of the region adjacent to the favored ports may have direct and systematized communication with practically all of the world's producing regions. It is a fact that the companies having the widest geographical range of operations and the greatest variety of services are those receiving subsidies. Owing to the interaction and linking together of the world's public carriers better organization of commerce in one part of the world has some effect in supplying the needs of all countries.

APPENDIX A.

BIBLIOGRAPHICAL NOTE.

The bibliographical references that can be made in connection with this monograph are few in number, because of the fact that the volume in large measure is the result of concrete studies of commercial activities rather than of published writings concerning them. Observation, private correspondence and personal interviews are at times more informing than books, but they do not make convenient references. During the many months that I assisted the Isthmian Canal Commission in their rate and traffic investigations I examined many volumes of unpublished statistics in Washington bureaus and in the New York custom house; I conducted an extensive correspondence with the representatives of steamship lines, importers, exporters and manufacturers, and in some cases personal interviews were obtained. Studies thus begun were continued in Europe. I spent a number of weeks in the cities of London, Liverpool, Glasgow, Leith and Edinboro, Southampton, Havre, Paris, Antwerp, Rotterdam, Hamburg, Bremen, Genoa, Leghorn and Venice. One-half of the actual time was spent in London and Liverpool. In nearly all of these cities I interviewed the American Consul, and spent much time in interviewing merchants and ship owners and in the further study of local commerce as shown in official statistics, "Commercial Relations of the United States" and the reports of local organizations, such as reports of Chambers of Commerce (including the American Chamber of Commerce in Paris) and private statistical sheets. This last class of material contains a vast amount of statistical information, and is rich in raising puzzles to be investigated. Some of these documents are those published by Liverpool Cotton Brokers' Association, General Brokers' Association, London Rice Brokers' Association, the Corn Trade Yearbook, reports issued by private firms engaged in the lumber, wool, tea, cocoa, rubber and other trades. Similar American sources have been drawn upon to a lesser extent; reports of San Francisco Chamber of Commerce, and the same for Chicago, New York Produce Exchange, and New Orleans Cotton Exchange. Some of the testimony before the Industrial Commission has a direct bearing upon Part I. Especial reference should be made to the official statistical volumes of leading nations.

For the chapter on the Panama canal further information may be obtained by examining the reports of the Isthmian Canal Commission, and the following articles upon Isthmian canal by Prof. Emory R. Johnson, member Isthmian Canal Commission: *Quarterly Journal of Economics,* August, 1902, and August, 1903; *Political Science Quarterly,* June, 1903; *Bulletin of the American Geographical Society,* April, 1903; December, 1903; *Railway World;* January 2, 9, 1904; *Everybody's Magazine,* February, 1904; *Journal of Geography,* January, February and March, 1902; *Independent,* December 31, 1903; *The Annals of American Academy of Political and Social Science,* January, 1902. See also an article by J. Russell Smith in *Annals,* December, 1901.

The reports of the United States Commissioner of Navigation contain much information upon ship building and tonnage, but the great original sources of information upon the shipping situation are *Lloyd's Register and Journal.* Further information upon the Government's control of shipping and of ocean routes may be found in the navigation laws of the United States and other countries, in the reports of the United States Hydrographic Office, the Coast Survey, the Life Saving Service, the Lighthouse Board, the Weather Bureau, and the reports of the Secretaries of Labor and Commerce, the Navy, and the Treasury.

For harbors and their control, see "Ports and Docks," Douglas Owen, Methuen & Co., London, 1904; Report of the Massachusetts State Board on Docks and Terminal Facilities, 1897; articles by J. Bruce Byall, Solomon Huebner and J. Russell Smith in *Annals of American Academy of Political and Social Science,* November, 1904; Report of Royal Commissioners on Port of London, 1902.

The chapter upon the handling of freight is, in nearly every paragraph, the result of direct observation. The best source of illustrations of this machinery is the illustrated catalogues of the firms manufacturing the various types of machinery.

APPENDIX B.

SOURCES FOR THE APPENDED MAP.

This map is based upon the United States Hydrographic Office map of steamer routes. The telegraph map from the same office (December, 1904) furnished the telegraph data. The coaling stations were taken from their last coaling station map, a publication which has been discontinued for several years. The emphasis upon coaling stations is furnished by the author. The sailing routes are in part from the Hydrographic Office pilot charts and sailing directions, but chiefly from H. Berghaus' chart of the world (1897). The latter is the authority for the winds. It should not be inferred that these routes are all mathematically followed on all occasions. Particular conditions of weather and other circumstances sometimes cause the navigator to vary the course from that charted. This is more often true of the captains of sailing than of steam vessels. No attempt has been made to present all of the routes. For a map of this charcter it would be a physical impossibility. Only the more important ones are shown. Both summer and winter sailing routes have been given only in a few cases where there is great variation between the two sets. Where this variation is small one route only is given. Persons desiring more detailed information can find it by consulting the sources referred to above.

The ocean cable net is complete except in some small and narrow seas. Only a few land conections are shown, and these are usually for the purpose of showing the number of seacoast places having connection with the world telegraph. An effort has been made to show the connection between land telegraph and the seacoast on all shores except those of Europe, and the United States, Canada, and Japan. It has, however, been impossible to mark or name the minor ports and signal stations having stations having these connections.

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